International Civil Aviation Organization
Organisation de l'aviation civile internationale
Organización de Aviación Civil Internacional
Международная организация гражданской авиации
منظمة الطيران المدني الدولي
国际民用航空组织

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Ref.: AN 4/1.1.58-23/33

30 May 2023

Subject: Proposal for the amendment of Annex 14, Volume I and PANS-Aerodromes (Doc 9981) relating to aerodrome design and operations

Action required: Comments to reach Montréal by 30 October 2023

Sir/Madam,

1. I have the honour to inform you that the Air Navigation Commission (ANC), at the seventh meeting of its 222nd Session held on 23 March 2023, considered proposals developed by the fourth meeting of the Aerodrome Design and Operations Panel (ADOP/4) to amend Annex 14 — *Aerodromes*, Volume I — *Aerodrome Design and Operations* and the *Procedures for Air Navigation Services (PANS) — Aerodromes* (Doc 9981).

2. The panel agreed on a consolidated package of proposed amendments to Annex 14, Volume I and PANS-Aerodromes which were developed by, inter alia, the Obstacle Limitation Surfaces Task Force (OLSTF) of the Aerodrome Design and Operations Panel (ADOP) over the course of more than seven years. The proposal introduced extensive amendments related to obstacle limitation surfaces, physical characteristics, visual aids, and aerodrome operations. The Commission authorized the transmission of the proposal to Contracting States and appropriate international organizations for comments.

3. The proposals for amendment to Annex 14, Volume I are contained in Attachment B and those for the PANS-Aerodromes are contained in Attachment C. To facilitate your review of the proposed amendments, a rationale box providing more information has been included immediately following each proposal. Due to the complexity of the amendment related to obstacle limitation surfaces, additional background information is also provided in Attachment A.

4. In examining the proposed amendment, you should not feel obliged to comment on editorial aspects as such matters will be addressed by the ANC during its final review of the draft amendment.

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5. May I request that any comments you wish to make on the amendment proposals be dispatched to reach me not later than 30 October 2023. To facilitate the processing of replies with substantive comments, I invite you to submit an electronic version in Word format to icaohq@icao.int. The ANC has asked me to specifically indicate that comments received after the due date may not be considered by the Commission and the Council. In this connection, should you anticipate a delay in the receipt of your reply, please let me know in advance of the due date.

6. For your information, applicability dates for the proposed amendments are envisaged as follows:

a) 27 November 2025 for provisions related to aerodrome design, visual aids and apron management service in Annex 14, Volume I and PANS-Aerodromes;

b) 26 November 2026 for provisions related to ground handling in Annex 14, Volume I; and

c) 23 November 2028 for provisions related to obstacle limitation surfaces in Annex 14, Volume I and PANS-Aerodromes.

Any comments you may have thereon would be appreciated.

7. The subsequent work of the ANC and the Council would be greatly facilitated by specific statements on the acceptability or otherwise of the amendment proposal.

8. Please note that, for the review of your comments by the ANC and the Council, replies are normally classified as “agreement with or without comments”, “disagreement with or without comments” or “no indication of position”. If in your reply the expressions “no objections” or “no comments” are used, they will be taken to mean “agreement without comment” and “no indication of position”, respectively. In order to facilitate proper classification of your response, a form has been included in Attachment D which may be completed and returned together with your comments, if any, on the proposals in Attachment B and C.

Accept, Sir/Madam, the assurances of my highest consideration.

Juan Carlos Salazar
Secretary General

Enclosures:

A — Background information
B — Proposed amendment to Annex 14, Volume I
C — Proposed amendment to PANS-Aerodromes
D — Response form

BACKGROUND INFORMATION

Proposed amendments to obstacle limitation surfaces

1. INTRODUCTION

1.1 The objective of the obstacle limitation surfaces (OLS), which were first introduced in the 1950s in Annex 14 — *Aerodromes*, Volume I — *Aerodrome Design and Operations*, is to ensure the safety of aircraft operations and the accessibility of the aerodrome to those intended operations. Currently, the existing OLS provide surfaces of fixed dimensions applicable to all aerodromes.

1.2 The Twelfth Air Navigation Conference (AN-Conf/12) and the 38th Session of the ICAO Assembly called for a comprehensive review of OLS in Annex 14, Volume I, considering the capabilities of modern aircraft operations and intended instrument procedures. ICAO established an expert OLS Task Force (OLSTF) under the Aerodrome Design and Operations Panel (ADOP) to review and update OLS provisions that ensure a safe and efficient use of an aerodrome and are consistent with existing or planned operations at the aerodrome.

1.3 The OLSTF, through quantitative studies using aircraft track data, observed that the dimensions of some existing OLS were over-conservative. For example, the width of inner edge of the approach surface for instrument runways was considerably larger than the observed deviations of aircraft at threshold, carrying out an instrument approach procedure. In addition, gaps were identified between the OLS-related provisions in Annex 14, Volume I, for aerodrome protection and those in the *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, Doc 8168) for flight procedure design, providing opportunities for improvements.

1.4 To this end, the OLSTF carried out extensive work over the past seven years and is now proposing significant changes to the provisions related to OLS.

2. PROPOSED CHANGES

2.1 The proposed OLS comprise two sets of surfaces: obstacle free surfaces (OFS) and obstacle evaluation surfaces (OES). The OFS and OES have distinct purposes and are applied based on the type of runway, aeroplane design group (ADG) and the instrument flight procedures available for that runway.

2.2 The main objectives of the proposed changes are to develop a set or sets of surfaces:

a) with clear purposes and characteristics ensuring that only the surfaces required are adopted;

b) that are performance-based; and

c) adaptable to the type of operations conducted at the aerodrome.

3. OBSTACLE FREE SURFACES (OFS)

It was observed that aircraft trajectories were similar in areas close to the runway, where the impact of obstacles to its operations would be unacceptable. In this area, the surfaces were designed with strict obstacle protection requirements to ensure that an airspace is free from obstacles. The obstacle free surfaces (OFS) will provide a volume of airspace necessary for safe and accessibile operations near the runway and in the vicinity of the aerodrome. As such, the volume of airspace is kept free from obstacles, except for existing obstacles and/or terrain which would have been assessed earlier.

4. OBSTACLE EVALUATION SURFACES (OES)

4.1 The obstacle evaluation surfaces (OES) are surfaces that are applied in addition to the OFS, where operations may be very different from one aerodrome to another and the impact of an obstacle could be highly variable, or where operations may adapt to the obstacle environment. Having OFS under such varying operational conditions at wider areas would result in a costly, over-conservative preservation of the airspace. Instead, the impact of obstacles in those areas should be assessed. OES intend to provide the volume of airspace where obstacles could impact the operations intended at the aerodrome. States would then evaluate their impact and decide whether obstacles were acceptable, after adequate mitigation measures. OES act as the triggering surfaces used when determining whether obstacles are acceptable for safe and regular operations at the aerodrome.

4.2 The new proposal provides flexibility to:

a) have OES of standard dimensions covering the most common types of operations;

b) modify the OES to address operations varying from the ones supporting the standard OES dimensions; and

c) adopt OES with specific characteristics and dimensions based on operational requirements.

5. AEROPLANE DESIGN GROUP (ADG)

5.1 The dimensions of OFS and OES are determined based on the new aeroplane design group (ADG) categorization. The ADG utilizes two criteria related to the aeroplane performance characteristics and dimensions. The first criterion is based on the aircraft's indicated airspeed at threshold and the second criterion on the aeroplane wingspan.

5.2 The aerodrome reference code (ARC) is used by airport planners for infrastructure design. However, the OLS need to be consistent with the flight operations criteria used in designing instrument flight procedures, which uses an approach speed category. While determining the ADG, the existing ARC categorization was analysed to ensure that the ARC to ADG transition, for the purpose of OLS requirements, can be done without affecting aerodrome infrastructure and flight operations.

5.3 The aircraft with similar behaviour were categorized in the aeroplane design group that can be covered by identical surfaces. The proposed ADG will be used in Annex 14, Volume I, Chapter 4, for the design of OLS. For ease of reference, the ARC number corresponding to the new ADG are as follows:

Aerodrome reference code (ARC)	1	2		3-4			
Aeroplane design group (ADG)	I	IIA	IIB	IIC	III	IV	V

6. EXPECTED BENEFITS

6.1 The new OLS concept is advantageous because while providing a set of harmonized requirements, it allows States to identify their own priorities and establish the most suitable application of those requirements, based on the operational environment and agreed development plans of the aerodrome. The benefits of the proposal include, but are not limited to:

a) identifying a clear purpose and characteristics of the surfaces, i.e., distinguishing surfaces that are closer to the runway, which are more critical for the safety of operations versus those farther away that are needed to ensure regularity of flight operations;

b) adopting only the surfaces that are required for the intended operations at an aerodrome, which may result in well-balanced aviation and land use needs;

c) adapting the surfaces based on the requirements of the aerodromes, instrument procedure designs and flight operations;

d) facilitating a better evaluation of obstacles through the conduct of aeronautical studies, which might not have been accounted for in the current OLS provisions for instrument flight procedures; and

e) ensuring the close collaboration of stakeholders (States, air navigation services provider (ANSP), aircraft operators, aerodrome operators, etc.) in the process of aeronautical study and decision making.

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PROPOSED AMENDMENT TO

INTERNATIONAL STANDARDS

ANNEX 14

TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

VOLUME I — *AERODROME DESIGN AND OPERATIONS*

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT

The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

1.	~~Text to be deleted is shown with a line through it.~~	text to be deleted
2.	New text to be inserted is highlighted with grey shading.	new text to be inserted
3.	~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading.	new text to replace existing text

PROPOSED AMENDMENT TO

INTERNATIONAL STANDARDS

ANNEX 14

TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

***AERODROMES*, VOLUME I**
AERODROME DESIGN AND OPERATIONS

INITIAL PROPOSAL 1
Definitions and abbreviations

CONTENTS

Page

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ABBREVIATIONS AND SYMBOLS

(used in Annex 14, Volume I)

Abbreviations

ADG Aeroplane design group

. . .

GBAS Ground-based augmentation system
GHSP Ground handling service provider
GSE Ground support equipment

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OES Obstacle evaluation surfaces

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OFS Obstacle free surfaces

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RDRS Runway distance remaining signs

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SBAS Satellite-based augmentation system

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TOD Terrain obstacle datasets

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ULD Unit load device

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V_{at} Indicated airspeed at threshold
Vso Stalling speed or the minimum steady flight speed in the landing configuration
Vs1g Stalling speed or the minimum steady flight speed in a specified configuration

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LIMITED INDEX OF SIGNIFICANT SUBJECTS INCLUDED IN ANNEX 14, VOLUME I

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RUNWAY

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distance remaining signs x.x

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INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES

CHAPTER 1. GENERAL

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6.2 1.1 Definitions

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Ground handling. Services necessary for an aircraft's arrival at, and departure from, an airport, other than air traffic services.

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Origin: GHTF/14 ADOP/4	*Rationale* Definition of ground handling is extracted from Annex 6, Part I.

INITIAL PROPOSAL 2
Obstacle limitation surfaces

1.8 Aeroplane Design Group

Applicable as of 23 November 2028

Note.— The intent of the Aeroplane Design Group (ADG) is to provide a simple method for interrelating the specifications for the management of obstacles around aerodromes. The ADG utilizes two criteria related to the aeroplane performance characteristics and dimensions. The first criterion is based on the indicated airspeed of the aircraft at threshold and the second criterion on the aeroplane wingspan.

See Chapter 4 on the application of ADG for the provisions of obstacle restriction and removal.

Origin: OLSTF 24 ADOP/4	*Rationale* The current code number in the aerodrome reference code (ARC) methodology does not reflect: - the airborne performances of aeroplanes with very different approach speeds belonging to Code number 1, ranging from less than 50 kt to 120 kt and more. Approach speed is a better criterion to represent the airborne performances of aeroplanes as it is currently used in the design of instrument flight procedures; and - the size of aircraft. On runways where the aircraft have highly different wingspans, the obstacle limitation surface (OLS) applicable may be similar (e.g. the OLS applicable to runways accommodating A380-800 and Lear Jet 45 are the same).

	Hence, the criteria reflecting the airborne performances and the wingspan of aeroplanes are suitable to establish OLS that match the operations and the size of aircraft more consistently. In the *Procedures for Air Navigation Services — Aircraft Operations*, Volume I — *Flight Procedures* and Volume II — *Construction of Visual and Instrument Flight Procedures* (PANS-OPS, Doc 8168), the indicated airspeed at threshold is the main parameter for the design of the obstacle clearance criteria ensuring the safety of instrument flight operations. Approach speed is an essential parameter to harmonize the surfaces in Annex 14, Volume I and PANS-OPS, Volumes I and II, since it is the main parameter for the design of instrument procedures and associated obstacle clearances. By incorporating instrument operations-related principles in Annex 14, Volume 1, Chapter 4, the gaps between the limitation of obstacles in the vicinity of aerodromes and the extent of airspace necessary for the operations of aeroplanes, including instrument procedures, no longer exists. The proposed classification is intended to be primarily used in Chapter 4 of Annex 14, Volume I, for the design of obstacle limitation surfaces.

1.8.1 An ADG shall be determined for each runway in accordance with the characteristics of the critical aeroplane for which the runway is intended.

1.8.2 The ADG shall be determined from Table 1-2, by selecting the ADG corresponding to the highest values of indicated airspeed at threshold and wingspan of the aeroplanes for which the runway is intended.

Note.— Indicated airspeed at threshold (V_{at}) is equal to the stall speed Vso multiplied by 1.3, or stall speed Vs1g multiplied by 1.23 in the landing configuration at the maximum certificated landing mass. If both Vso and Vs1g are available, the higher resulting V_{at} applies.

Origin: OLSTF 24 ADOP/4	*Rationale* These Standards mandate the necessity to determine the ADG for each runway. This ensures that the ADG selected are consistent with the operations on each runway.

Table 1-2. Aeroplane Design Group
(see 1.8.2 to 1.8.3)

(Applicable as of 23 November 2028)

Aeroplane Design Group	Indicated airspeed at threshold		Wingspan
I	Less than 169 km/h (91 kt)	and	Up to but not including 24 m
IIA	Less than 169 km/h (91 kt)	and	24 m up to but not including 36 m
IIB	169 km/h (91 kt) up to but not including 224 km/h (121 kt)	and	Up to but not including 36 m
IIC	224 km/h (121 kt) up to but not including 307 km/h (166 kt)	and	Up to but not including 36 m
III	Less than 307 km/h (166 kt)	and	36 m up to but not including 52 m
IV	Less than 307 km/h (166 kt)	and	52 m up to but not including 65 m
V	Less than 307 km/h (166 kt)	and	65 m up to but not including 80 m

Origin: OLSTF 24 ADOP/4	*Rationale* Table 1-2 depicts the various aeroplane design groups based on the indicated airspeed at threshold and wingspan: two essential parameters for establishing the OLS. The lower and upper limits for the indicated airspeed at threshold and wingspan specified in each group respectively correspond to the aircraft categories specified in, PANS-OPS (Doc 8168) and the code letter as specified in the ARC of Annex 14, Volume I, Chapter 1, 1.6. Hence, the grouping can be easily correlated with other provisions in Annex 14, Volume I and PANS-OPS, Volumes I and II that use code letter and indicated airspeed at threshold. **Upper limit of indicated airspeed at threshold** PANS-OPS, Volumes I and II provide a categorization of aircraft with an indicated airspeed at threshold of 307 km/h (166 kt) or more but less than 391 km/h (211 kt). In Table 1-2, the ADG I to V address aeroplanes that have indicated airspeed at threshold up to but not higher than 166 kt, since civil aircraft have approach speeds lower than 166 kt. Retaining an upper limit higher than 166 kt would have resulted in the horizontal surfaces having unnecessarily wide radii for those civil aeroplanes. Where aeroplanes (e.g. military aeroplanes) have an indicated airspeed at threshold above 166 kt and up to 211 kt, they could be affected in the ADG IIC, III, IV or V according to their wingspan. In which case, the dimensions of the obstacle evaluation surface (OES) (especially the horizontal surface) would need to be increased.

Note 1.— Detailed specifications concerning the application of the aeroplane design group are given in the Airport Services Manual, *Part 6* — Control of Obstacles *(Doc 9137).*

Note 2.— The following examples illustrate how the ADG is determined.

Example 1.— If the critical aeroplane that the runway is intended to serve has an indicated airspeed at threshold of 161 km/h (87 kt) and a wingspan of 20 m, then the aeroplane design group would be I.

Example 2.— If the critical aeroplane that the runway is intended to serve has an indicated airspeed at threshold of 224 km/h (121 kt) and a wingspan of 52 m, then the aeroplane design group would be IV.

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Origin: OLSTF 24 ADOP/4	*Rationale* The note and examples illustrate how to select the appropriate ADG for a runway, considering the critical aeroplane. Further guidance will be provided in the *Airport Services Manual*, Part 6 — *Control of Obstacles* (Doc 9137).

CHAPTER 3. PHYSICAL CHARACTERISTICS

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3.12 Holding bays, runway-holding positions, intermediate holding positions and road-holding positions

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Location

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3.12.9 Until 22 November 2028, Tthe location of a runway-holding position established in accordance with 3.12.3 shall be such that a holding aircraft or vehicle will not infringe the obstacle free zone, approach surface, take-off climb surface or ILS/MLS critical/sensitive area or interfere with the operation of radio navigation aids.

3.12.9 As of 23 November 2028, the location of a runway-holding position established in accordance with 3.12.3 shall be such that a holding aircraft or vehicle will not infringe the inner approach surface, inner transitional surfaces, balked landing surface, approach surface, take-off climb surface or ILS/MLS critical/sensitive area or interfere with the operation of radio navigation aids.

Origin: OLSTF 24 ADOP/4	*Rationale* In the proposed concept, inner approach and inner transitional surfaces are implemented on all runways (and the balked landing surface is established only on precision approach runways where the obstacle free zone consisting of the inner approach, inner transitional and balked landing surfaces are in place) in order to limit fixed objects including mobile objects such as holding aircraft. Hence, the location of runway holding position shall be such that holding aircraft and vehicle will not infringe the inner approach surface, inner transitional surface, and balked landing surface. Note that the characteristics and dimensions of the inner approach surface, inner transitional surface and balked landing surface are reviewed and designed in such a way that they will not affect the existing runway holding positions.

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CHAPTER 4. OBSTACLE RESTRICTION AND REMOVAL

Applicable until 22 November 2028.

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Insert new text as follows:

CHAPTER 4. OBSTACLE RESTRICTION AND REMOVAL

Applicable as of 23 November 2028.

Note 1.— This chapter describes the management of obstacles within the aerodrome boundary and in its vicinity. The following specifications allow States to define the airspace around aerodromes to be maintained free from obstacles and the airspace where flexibility can be applied in managing the obstacle environment. This permits the existing and intended aeroplane operations at the aerodromes to be conducted safely and prevent the aerodromes from becoming restricted and eventually unusable by the growth of obstacles.

This is achieved by establishing obstacle limitation surfaces (OLS) consisting of obstacle free surfaces (OFS) and obstacle evaluation surfaces (OES).

Note 2.— The lateral and vertical extent of the OLS are being used in defining the requirements for the collection of terrain and obstacle data sets. Provisions on terrain and obstacle data sets are contained in Annex 15 — Aeronautical Information Services, *Chapter 5.*

Note 3.— The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in Chapter 5, 5.3.5.41 to 5.3.5.45.

Origin: OLSTF/24 ADOP/4	*Rationale* The OFS defines an obstacle free airspace near the runway. The OES defines a volume of airspace where the impact of obstacles on the operations of aeroplanes can be evaluated to help States decide on the acceptability of these obstacles. Together, OFS and OES compose of the OLS that ensure obstacles are controlled and accounted for the safety of operations and the accessibility of flight procedures for the intended operations to the aerodrome. Note 2 emphasizes the role of OLS in supporting terrain and obstacle dataset (TOD) for the collection of terrain and obstacle data as stipulated in Annex 15 and PANS-AIM (Doc 10066). Note 3 refers to the existing provisions in Annex 14, Volume I on obstacle protection surface for visual approach slope indicator systems. Secretariat note: *It is proposed to add detailed background information in the consultation letter to States to better clarify the subject of OLS.*

4.1 General

4.1.1 States shall establish a process to prevent the growth of obstacles, both fixed and mobile, that may affect the safety or regularity of flight operations at an aerodrome.

Note 1.— Specifications concerning the process to be established by the State are contained in PANS-Aerodromes *(Doc 9981), Part II, Chapter 10.*

Note 2.— Taxiing aircraft and traversing vehicles are considered mobile objects whereas buildings, parked aircraft and vehicles are considered fixed objects.

Origin: OLSTF/24 ADOP/4	*Rationale* A process is necessary to establish a coordinated approach amongst aviation and non-aviation stakeholders in managing obstacles. This process must ensure comprehensive management of obstacles in coordination with the zoning laws or other applicable systems. For example, States must ensure: a) the legal possibility of forbidding obstacles or having them evaluated before taking a decision on their acceptability when they infringe specified surfaces; b) that all existing or proposed development of objects are below the specified obstacle limitation surfaces. The absence of a coordinated process could result in an improper management of obstacles, with possible developments that could adversely affect the safety of operations and accessibility of aerodromes. Note 2 was included to define a mobile object.

4.2 Obstacle free surfaces (OFS)

Note.— The purpose of the obstacle free surfaces is to establish a minimum volume of airspace that preserves the accessibility of the aerodrome and the safety of operations by protecting aeroplanes during approaches, take-offs and go-arounds.

Origin: OLSTF/24 ADOP/4	*Rationale* The introductory note provides an explanation on the purpose of the obstacle free surfaces in order to clarify the understanding and application of these proposed surfaces. Throughout this proposal a note has been introduced for all the proposed surfaces to provide a short description of their operational objectives. This is done in order to facilitate the understanding of the proposed surfaces in the context of a major change of concept.

4.2.1 Approach surface

Note1.— The purpose of the approach surface is to establish the airspace to be maintained free from obstacles to protect an aeroplane in the visual phase of the approach-to-land manoeuvres following a standard 3.0° approach. See Figure 4-1.

Origin: OLSTF/24 ADOP/4	*Rationale* The note gives the specific operational objective of the approach OFS, that is to protect the visual phase of an approach following the standard 3.0° slope. The slope of 3.0° applies to the majority of approaches. Hence, it was used as a hypothesis for the design of the approach surface.

4.2.1.1 *Description*. An inclined surface preceding the threshold.

Origin: OLSTF/24 ADOP/4	*Rationale* The proposed approach surfaces consist of a surface comprised in a single inclined plane.

4.2.1.2 *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.

4.2.1.3 The surface mentioned in 4.2.1.2 shall be varied when lateral offset, angular offset or curved approaches are utilized; two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the lateral offset, angular offset or curved ground track.

4.2.1.4 The elevation of the inner edge shall be equal to the elevation of the midpoint of the threshold.

4.2.1.5 The slope of the approach surface shall be measured:

a) when straight-in approaches are utilized — in the vertical plane containing the centre line of the runway and its extension; and

b) when lateral offset, angular offset or curved approaches are utilized — along any straight part of the approach, in the vertical plane containing the centre line of the lateral offset, angular offset or curved ground track or, along any curved part of the approach, in the vertical plane tangent with the curved ground track.

Origin: OLSTF/24 ADOP/4	*Rationale* 4.2.1.2 Provides the characteristics of the approach surface and 4.2.1.3 explains the elevation requirements of its inner edge. The plane in which the slope shall be measured is different depending on the approach path. 4.2.1.5 a) describes the most general scenario of a straight-in approach while point b) addresses the less common approaches, where the plane is specified differently on curved and straight parts of the approach path.

4.2.1.6 Except where the approach surface is raised to comply with approach angles greater than 3.0°, the slope of the approach surface shall not be greater than, and their other dimensions not less than, those specified in Table 4-1 for non-instrument runways and Table 4-2 for instrument runways.

Origin: OLSTF/24 ADOP/4	*Rationale* A standard approach slope of 3.0° is used in designing the approach surface. Hence, where the approach angle is 3.0°, the dimensions proposed in Table 4-1 and Table 4-2 shall be applicable. However, the approach surface consistent with the standard approach angle of 3.0° and the dimensions in Table 4-1 and Table 4-2 would be over conservative where approach trajectories

	follow an angle higher than 3.0°. Hence, the standard implicitly authorizes an adjustment of the dimensions of the surface where the approach angle is higher than 3.0° (As the dimensions in Table 4-1 and Table 4-2 are conservative, the changes to the approach surface with an angle higher 3.0° are considered safe). In addition, the approach surface consistent with the dimensions in Table 4-1 and Table 4-2 would be insufficient where approach trajectories follow an angle lower than 3.0°. This scenario is addressed later in 4.2.1.8 and 4.2.1.9 and in footnote (e) in Table 4-1 and Table 4-2.

4.2.1.7 **Recommendation.**— *The slope of the approach surface should not be increased to facilitate the growth of obstacles.*

Note.— The slope of the approach surface is intended to adapt to approach operations that have a slope higher than 3.0°. Specifications concerning the modification of the approach surface are contained in PANS-Aerodromes *(Doc 9981), Part II, Chapter 10.*

Origin: OLSTF/24 ADOP/4	*Rationale* Recommendation 4.2.1.7 is necessary to prevent the abuse of the adaptability of approach OFS to be used by States in increasing the approach surface for the sole purpose of allowing new obstacles. This provision is a recommendation and not a standard as there may be other situations where the States need to be provided with the flexibility to allow obstacles or due to historic reasons, have angle of approach higher than 3.0°. The associated note intends to be more precise on the reason that should justify the increase of the slope of the approach surface. The slope should be adjusted to cater to approach operations that have an angle higher than 3.0°, but the slope of the surface should not be increased to raise the angle of approach operations and enable new obstacles.

4.2.1.8 Where the approach angle is lower than 3.0°, the slope of the approach surface shall be decreased.

4.2.1.9 Where the slope of the obstacle protection surface of a visual approach slope indicator system is lower than that indicated in Table 4-1 and Table 4-2, the slope of the approach surface shall be decreased to match that of the obstacle protection surface.

Note.— See Chapter 5, 5.3.5 on the obstacle protection surface.

4.2.1.10 Where the slope of the approach surface is reduced, corresponding adjustment in the length of the approach surface shall be made to provide protection to a height equal to that reached with the slopes and lengths in Table 4-1 and Table 4-2.

4.2.1.11 On instrument approach runways, where the obstacle clearance height is higher than 150 m (500 ft) above the threshold, the length of the approach surface shall not be less than:

a) the value indicated in Table 4-2; or

b) that necessary to reach the obstacle clearance height;

whichever is greater.

Origin: OLSTF/24 ADOP/4	*Rationale* As the slope of the approach surface may be adjusted to adapt to operations, it is necessary to indicate that the slope of the approach surface can be lowered where the approach slope is lower than 3.0°. If such adjustments are not made, the slope provided in Table 4-1 and Table 4-2 would be insufficient to safely cover operations following approach slopes lower than 3.0°. Lowering the slope of the surface is necessary to maintain a safe clearance above obstacles below the approach surface. Similarly, where there is a visual approach slope indicator with an obstacle protection whose slope is lower than those indicated in Table 4-1 and Table 4-2, the slope of the approach surface should be decreased. This is to ensure the consistency between the surfaces intended to ensure the protection of operations in the visual phase of flight. Where the slope of the approach surface is lower than those indicated in Table 4-1 and Table 4-2, the length of the surface must be increased to ensure that the surface reaches the height normally reached by the same surface with the dimensions indicated in Table 4-1 and Table 4-2 and meet the operational objective (i.e. protecting aircraft from a given height above the threshold). Finally, 4.2.1.11 ensures that the approach surface protects the visual phase of instrument approaches, where the minima make this phase of flight longer than the default length provided in Table 4-2. However, the length in Table 4-2 is not proposed to be decreased where the slope of the approach surface is increased and the minima are such that the surface reaches them before the length stipulated in Table 4-2.

Table 4-1. Dimensions and slopes of approach surface — Non-instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m
Length of inner edge	60 m[a b]	80 m[c d]	100 m[d]	125	135 m	150 m
Divergence	10 %	10 %	10 %	10 %	10 %	10 %
Length	1 600 m[e]	2 500 m[e]	2 500 m[e]	2 500 m[e]	2 500 m[e]	2 500 m[e]
Slope	5 %[f]	4 %[f]	3.33 %[f]	3.33 %[f]	3.33 %[f]	3.33 %[f]

[a] Where runway width is above 23 m and up to 30 m, the inner width is increased to 80 m.
[b] Where runway width is above 30 m, the inner width is increased to 100 m.
[c] Where runway width is above 30 m and up to 45 m, the inner width is increased to 100 m.
[d] Where runway width is above 45 m, the inner width is increased to 110 m.
[e] See 4.2.1.10.
[f] See 4.2.1.8 and 4.2.1.9.

Origin: OLSTF/24 ADOP/4	*Rationale* Statistical analysis and modelling of approach trajectories were not reliable in determining the dimensions of the approach surface on non-instrument runways. It was assessed that such trajectories did not reflect the performances of aircraft and capabilities of pilots. In a visual approach environment where pilots are required to see and avoid obstacles, extreme deviations of aeroplanes are not uncommon. These deviations splayed even beyond the current obstacle limitation surfaces and as such would not be reliable if used in designing a

	consistent approach surface. Due to the reasons above, the dimensions in Table 4-1 rely on the dimensions provided in Annex 14, Volume I, Chapter 4 (ninth edition) and are adapted to the classification in aeroplane design groups. Additional information and guidance provided in *Airport Services Manual* (Doc 9137), Part 6.

Table 4-2. Dimensions and slopes of approach surface — Instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Distance from threshold	60 m	60 m	60 m	60 m	60 m	60 m
Length of inner edge	110[a] m	125 m[b]	155 m[c]	175 m	185 m	200 m
Divergence	10%	10%	10%	10 %	10%	10%
Length	4 500 m[d]	4 500 m[d]	4 500 m[d]	4 500 m[d]	4 500 m[d]	4 500 m[d]
Slope	3.33%[e]	3.33%[e]	3.33%[e]	3.33%[e]	3.33%[e]	3.33%[e]

[a] When the runway width is above 30 m, the inner width is increased to 125 m.
[b] When the runway width is above 30 m, the inner width is increased to 140 m.
[c] When the runway width is 30 m or less, the inner width is decreased to 140 m.
[d] See 4.2.1.10 and 4.2.1.11.
[e] See 4.2.1.8 and 4.2.1.9.

Origin: OLSTF/24 ADOP/4	*Rationale* On instrument approach runways, the lateral dimensions above are based on the statistical analysis of 135 000 approach trajectories. The group initially intended to establish the statistical envelops necessary to contain the approach trajectories with a statistical containment probability of $4*10^{-8}$. These envelops would then be used to define the necessary approach surface. The value of $4*10^{-8}$ comes from the: a) targeted probability of accident of 10^{-7} on the whole flight; b) the ratio of accidents occurring in the approach phase (40 per cent , see Boeing, *Statistical summary of Commercial Jet Airplane Accidents – Worldwide operations | 1959 – 2017* and Civil Aviation Authority, *Global Fatal Accident review – 2002 to 2011*). The OLSTF analysed the method used to gather and filter the data tracks and assessed that the trajectories are satisfying to model the lateral shape of the approach surfaces on instrument approach runways. The trajectories were measured over several years on many aerodromes and include a variety of weather conditions, aerodrome elevations, runway lengths and widths providing a good representation of all possible environments. Distance from threshold The current value of 60 m is retained.

	Length of the inner edge and divergence The length of the inner edge and the lateral divergence of the surface in the table above come from the statistical modelling of approach trajectories. The lateral position provided in the trajectories was assessed accurate enough to allow a consistent statistical modelling of the trajectories. Thus, the group modelled the lateral deviations of aircraft and identified the lateral dimensions of the approach surface necessary to contain the trajectories with a probability of $4*10^{-8}$. In fact, the value of 140 m that is retained for aeroplane design groups IIA and IIB on 45 m wide runways corresponds to the existing value applicable to non-precision and precision approach runways of code number 2. For aeroplanes of ADG I, where the wingspan is narrower, the necessary protection on similar runways is naturally narrower. Finally, on runways narrower than 45 m, the previous values are reduced, consistently with the better alignment of aircraft at threshold. Slope and length The vertical accuracy of the available trajectories were evaluated. The elevation of aircraft being derived from the information of the transponder, it is too inaccurate to provide a solid vertical position of aircraft. This inaccuracy does not enable to model an optimal vertical profile of the approach surface hence, the vertical dimensions in the table above are determined differently. For all aeroplane design groups, the slope is fixed to 3.33 per cent (except where the approach angle is different from 3.0° and the slope of the approach surface must be adjusted to prevent being over-conservative or less conservative in limiting obstacles). This slope is consistent with that of: a) the visual segment surface (3.28 per cent for an approach angle of 3.0°, see PANS-OPS, Volume II, Part I, Section 4, Chapter 5, 5.4.6.2), and hence satisfying to ensure adequate protection of aircraft in the visual phase of instrument approach procedures; b) the obstacle protection surface of a precision approach path locator (PAPI) aligned on approach angle of 3.0°, and hence relevant to limit obstacles that may affect aeroplanes using a PAPI in the visual phase of the approach. Note that in case of instrument landing system (ILS), and where the obstacle protection surface of the PAPI needs to be lowered to 3.22 per cent to align with the signal of the ILS (see Annex 14, Chapter 5, Figure 5-20 and Table 5-3), the slope of the approach surface should be decreased to the same value to limit obstacles between the slopes of 3.33 per cent and 3.22 per cent. This correction also applies in case of T visual approach slope indicator system (T-VASIS) and abbreviated T-VASIS (AT-VASIS). *Note. — The slope of 3.33 per cent is satisfactory* for the protection of aircraft in the visual phase of instrument approaches. However, it is not intended to limit all obstacles that may affect instrument approach operations, as the surfaces necessary for such operation can be highly different between aerodromes. These obstacle are addressed by the obstacle evaluation surfaces. For all aeroplane design groups, the length of the surface provides a protection to a height of 500 ft above the threshold. This enables the surface to get to the height of typical instrument

	approach minima, where aircraft can carry out the visual phase of instrument approaches. This objective is consistent with the general purpose of the approach surface, which is the protection of aircraft in the visual phase of the approach.

4.2.2 Transitional surfaces

Note.— The purpose of the transitional surfaces is to establish the volume of airspace to be maintained free from fixed obstacles to protect an aeroplane in the overflight of the runway or go-around manoeuvre following a standard 3.0° approach, beyond the approach surface. See Figure 4-1.

Origin: OLSTF/24 ADOP/4	*Rationale* The note gives the specific operational objective of the transitional surfaces. It is to protect the aeroplanes during the overflight of the runway (i.e. after crossing the inner edge of the approach surface) or go-arounds initiated during an approach following the standard 3.0° slope. Practically, the transitional surfaces cover the volume of airspace that is needed to protect aeroplanes descending to the runway or in the climb phase of a go-around manoeuvre where the approach surface does not provide protection.

4.2.2.1 *Description.— Transitional surfaces.* A complex surface along and at a specified distance from the runway centre line and part of the side of the approach surface that slopes upwards and outwards to a specified height.

4.2.2.2 *Characteristics.—* The limits of a transitional surface shall comprise:

a) a lower edge beginning on the side of the approach surface at the elevation of the upper edge and extending down the side of the approach surface to the inner edge of the approach surface and from there along a line extending parallel to and at a specified distance from the runway centre line and its extension, to the end of the strip; and

b) an upper edge located at 60 m above the elevation of the highest threshold of the runway.

Origin: OLSTF/24 ADOP/4	*Rationale* The transitional surfaces do not end at the intersection with the inner horizontal surface as per current provisions. The inner horizontal surface will be replaced by a series of horizontal OES, which by function, is not connected to the transitional surface. Hence, the description of the lower edge is adjusted, and the elevation of the upper edge was reviewed. The upper height of 60 m is assessed sufficient to protect aircraft reaching a height of 150 m (or 500 ft, which is the height that is retained for the protection of aircraft in the visual phase of the approach to land manoeuvres, see the rationale boxes associated with Tables 4-2 and 4-3). The vertical datum taken as a reference is the height of the runway threshold that is the highest for that runway or aerodrome. This ensures the top heights of the transitional surfaces specified at both thresholds to be conservative and identical (which end at the same height, making it easier to implement the surfaces and its application in limiting obstacles).

4.2.2.3 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 runway centre line and its extension after the threshold — 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 surfaces along the line parallel to the runway centre line will be curved if the runway profile is curved, or a plane if the runway profile is a straight line. The upper edge of the transitional surfaces will also be a curved or a straight line depending on the runway profile.

4.2.2.4 The slope of the transitional surfaces shall be measured in a vertical plane perpendicular to the vertical plane containing the runway centre line or its extension.

4.2.2.5 On non-instrument, non-precision approach and precision approach runways, the slope of the transitional surface shall not be greater than 20 per cent.

<table>
<tr>
<td>Origin:
OLSTF/24
ADOP/4</td>
<td>Rationale

4.2.2.3
This is similar to the existing provisions, however, in b), the reference to the strip is removed since the obstacle free surfaces are disconnected from the strip.

4.2.2.4
In the existing Annex 14, Volume I, 4.1.16, the expression “vertical plane at right angles to the centre line of the runway” is confusing as, in case of a non-level portion of the runway centre line, the plane at right angle to the centre line of the runway is not vertical. Instead, the vertical plane containing the centre line of the runway can be specified, and another vertical plane, at right angle with the previous, can serve as a reference to measure the slope.

4.2.2.5
Only the slope of the transitional surface needs to be specified as the contours of the surface. This is described in 4.2.2.2 and 4.2.2.3.

The slope of 20 per cent is consistent with:

a) the observed behaviour of aircraft on approach: the lateral divergence of 10 per cent and the slope of 3.33 per cent result in a lateral slope of 33.3 per cent;

b) the observed and expected performances of aircraft on go-arounds. Aircraft are expected to have:

1) a lateral deviation of 10 per cent or less (see Doc 9137, Part 6, 1.2.6.2, where the design of the OFZ relies on this hypothesis); and

2) a climb rate of 2.5 per cent or more (see PANS-OPS, Volume 1, Part II, Section 5, paragraph 7.5.2). This climb rate of 2.5 per cent is conservative in comparison with that of 3.33 per cent, which is retained for the design of the balked landing surface.</td>
</tr>
</table>

	Hence, the resulting slope necessary to cover the climb phase of go-around manoeuvres is 25 per cent. However, as a more conservative slope of 20 per cent currently applies to some runways, it was retained.

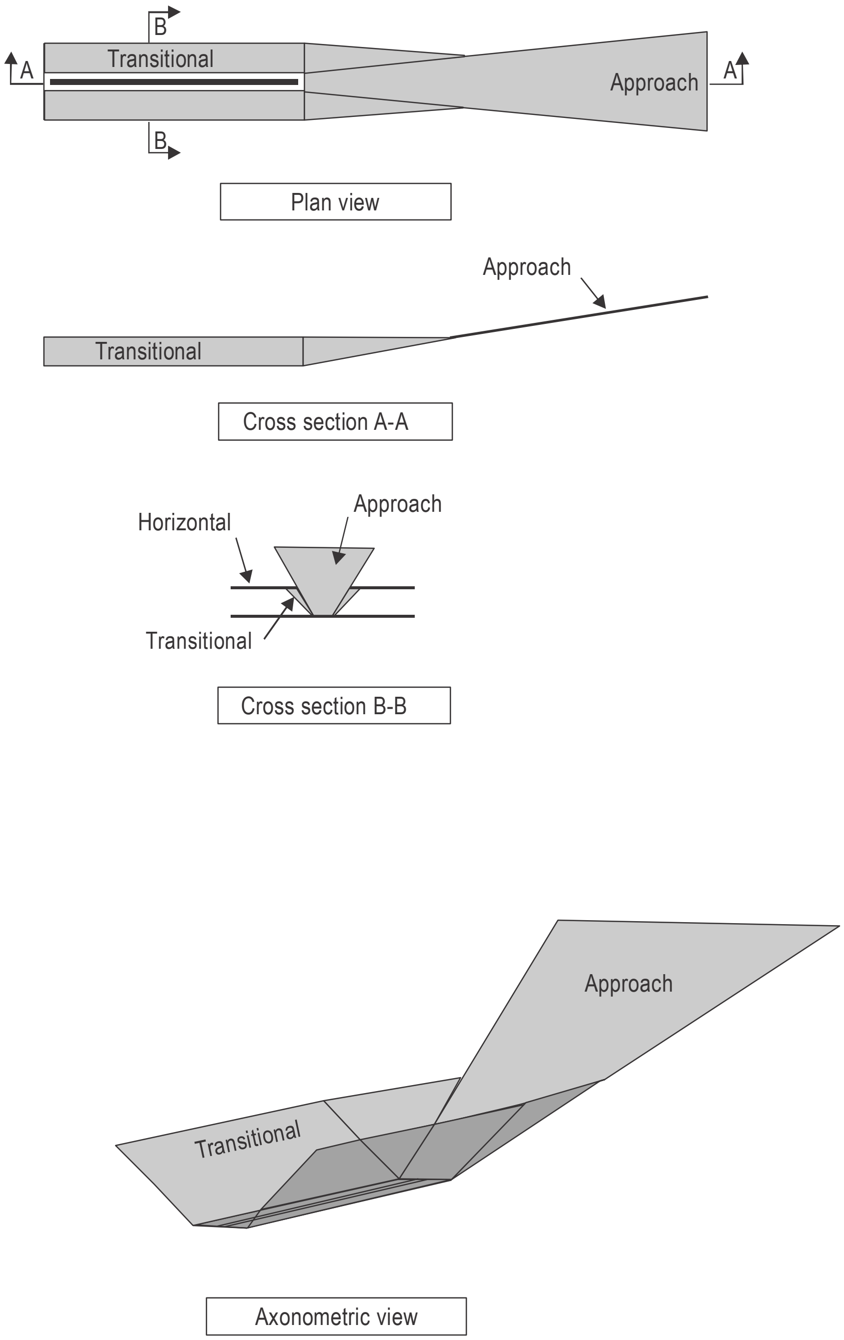


Figure 4-1. Approach surface and transitional surfaces

4.2.3 Inner approach surface

Origin: OLSTF/24 ADOP/4	*Preliminary rationale* On precision approach runways of categories II and III, the requirement of having mandatory OFZ is mainly to limit mobile objects. However, currently on precision approach runways of category I, the requirement of establishing an OFZ is only a recommendation. It is proposed to elevate this recommendation into a Standard, in order to harmonize the limitation of mobile objects on all precision approach runways. As the OFZ is already established on precision approach runways of category I in most States, no adverse impact is expected with the elevation of the recommendation to a Standard. The elevation of the recommendation to a Standard naturally increases the safety of operations. On precision approach runways of category I, the minima can be as low as 75 m (250 ft), which is only 15 m (50 ft) higher than the lowest minima of category II precision approaches. For similar approach trajectories, the difference of 15 m (50 ft) results in a short time difference between the acquisition of the minima; with an approach speed of 120 kts, a pilot following a 3.0° approach will reach 75 m (250 ft) less than 5 s before reaching 60 m (200 ft). This implies that pilots have only an additional delay of 5 s to see and avoid an obstacle. Considering this small difference, the OLSTF proposes the OFZ to be a standard on all precision approach runways. Finally, the Flight Operations Panel (FLTOPSP) and the Instrument Flight Procedures Panel (IFPP) did not see an adverse impact to the mandatory implementation of OFZ on precision approach runways of category I. Hence, the following SARPs related to inner approach surface, inner transitional surfaces and balked landing surface make no difference between the different categories of precision approach runways.

Note.— The inner approach surface protects an aeroplane against fixed and mobile obstacles before the threshold, in the descent phase of the balked landing or late go-around manoeuvres following a standard 3.0° approach. See Figure 4-2 and Figure 4-3.

Origin: OLSTF/24 ADOP/4	*Rationale* The above note gives the specific operational objective of the inner approach surface: the protection of aeroplanes during late go-arounds and balked landing manoeuvres initiated during a straight-in approach following the standard 3.0° slope. The inner approach surface preserves the descent phase before the threshold while the remaining part of the descent phase and the climb phase are protected by the inner transitional surface.

4.2.3.1 *Description.— Inner approach surface.* A rectangular portion of the approach surface immediately preceding the threshold.

Origin: OLSTF/24 ADOP/4	*Rationale* The inner approach surface is a subset of the approach surface. In addition to protecting aircraft against fixed objects, the surface also safeguards the operations against mobile objects, for all runways.

4.2.3.2 *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.

4.2.3.3 The surface mentioned in 4.2.3.2 shall be varied when lateral offset, angular offset or curved approaches are utilized; two sides originating at the ends of the inner edge and extending parallel to the extended centre line of the lateral offset, angular offset or curved ground track.

Origin: OLSTF/24 ADOP/4	*Rationale* The inner approach surface needs to be consistent with the trajectory of aircraft. Hence, where the approach is non-straight (e.g. with angular or lateral offset, or curved), the inner approach surface may not necessarily be rectangular and needs to be adjusted.

4.2.3.4 The dimensions of the inner approach surface for non-instrument runway shall not be less than those specified in Table 4-3.

4.2.3.5 The dimensions of the inner approach surface for non-precision approach runway shall not be less than those specified in Table 4-4.

4.2.3.6 The dimensions of the inner approach surface for precision approach runway shall not be less than those specified in Table 4-5.

4.2.3.7 If the slope of the approach surface is reduced, the length of the inner approach surface shall be increased to provide protection to a height of 45 m (150 ft).

Origin: OLSTF/24 ADOP/4	*Rationale* The dimensions of the inner approach surface need to be different on non-instrument, non-precision and precision approach runways as: a) the slope of the approach surface may vary. This implies that the length of the surface is necessarily different since the objective of the surface is to reach a height of 45 m; and b) the holding positions are located at different distances from the runway centre line. The inner approach surface is designed in such a manner that an aircraft at the holding positions should not infringe the inner approach surface (where the holding positions are further away from the centre line, the inner edge of the inner approach surface needs to be longer). Hence the need to have different standards to refer to the different dimensions.

Table 4-3. Dimensions of inner approach surface — Non-instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Length of inner edge	60 m	80 m	100 m	120 m	120 m	120 m[a]
Length	900 m[b]	1 125 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]

[a] The width is increased to 140 m on those aerodromes that accommodate a code letter F aeroplane that is not equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre.

[b] See 4.2.3.7.

Table 4-4. Dimensions of inner approach surface — Non-precision approach runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Length of inner edge	80 m	80 m	120 m	120 m	120 m	120 m[a]
Length	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]

[a] The width is increased to 140 m on those aerodromes that accommodate a code letter F aeroplane that is not equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre.

[b] See 4.2.3.7.

Table 4-5. Dimensions of inner approach surface — Precision approach runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Length of inner edge	90 m	90 m	120 m	120 m	120 m	120 m[a]
Length	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]

[a] The width is increased to 140 m on those aerodromes that accommodate a code letter F aeroplane that is not equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre.

[b] See 4.2.3.7.

Origin OLSTF/24 ADOP/4	*Rationale:* The slope of the surface does not need to be specified, as the inner approach surface is included in the approach surface. <u>Non-instrument and non-precision approach runways (Table 4-3 and Table 4-4)</u> *Length of the inner edge* The rationale supporting the length of the inner edge of the inner approach surface is discussed in the rationale box associated with Tables 4-6, 4-7 and 4-8. The length of the inner edge is determined after assessing the appropriate position of the inner transitional surface (which corresponds with the extremity of the inner edge of the inner approach surface).

Length of the surface

Considering that the inner approach surface on precision approach runways reaches a height of 45 m and is safe for the protection of precision approaches, an inner approach surface of similar height should provide a satisfying protection to approaches on non-instrument and non-precision approach runways.

Hence, the length of the inner approach surface is determined so that the considered surface on non-instrument and non-precision approach runways is similar to that on precision approach runways or rises to a height of 45 m.

Therefore, on non-precision approach runways and non-instrument runways of aeroplane design groups IIC to V, the length of 1 350 m is retained. On non-instrument runways of aeroplane design groups I to IIB, the length is adjusted so that, combined with the applicable slope, the surfaces rises to 45 m (i.e. 900*0.05=45 and 1 125*0.04=45).

Precision approach surfaces (Table 4-5)

On precision approach runways, the OFZ is maintained. However, two modifications are made.

The first modification concerns the translation of the dimensions of the OFZ from the existing classification on code numbers into the proposed classification on aeroplane design groups. The following conversion is used:

Code number	1	2		3-4			
Aeroplane design group	I	IIA	IIB	IIC	III	IV	V

Length of the inner edge

The above conversion table combined with the current following values of the length of the inner edge (see Table 4-1 Annex 14, Volume I (ninth edition) result in the lengths of the inner edge in Table 4-6.

Code number	**1-2**	**3-4**
Aeroplane design group	90 m	120 m*

*Where the code letter is F (Table 1-1), the width is increased to 140 m except for those aerodromes that accommodate a code letter F aeroplane equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre

The second modification concerns the increase of the height of the OFZ from 45 m to 60 m. This increase is consistent with both:

a) the implementation of the OFZ on precision approach runways of category I, where the OCH can be as low as 60 m; and

b) the improvement of the accessibility of precision approach runways of category II. In order to enable the accommodation of precision approaches of category III on precision approach runways of category II where the OCH is higher than 45 m but below 60 m, the OLSTF proposes to raise the height of the OFZ to the targeted OCH of 60 m (this possibility is described in PANS-OPS, Volume II, Part II, Section 1, Chapter 1, 1.1.3 h).

	Note. — The height of 60 m is also conservative for the limitation of mobile objects near the runway, as such objects should rarely reach comparable heights. *Length of the surface* With the increase of the height of the inner transitional and balked landing surfaces from 45 m to 60 m, the length needs to be adjusted. Experts from the IFPP provided the following formula which gives the necessary length of the inner approach surface, where the OCH is 60 m and the slope is 0.0322 (i.e. the most conservative slope of the approach surface): $$Length_{Inner\ App} = \frac{OCH + 900 * 0.0322 - 45}{0.0322}$$ The corresponding length is 1 366 m and corresponds to a height of 44 m. Hence, the length of the inner edge is rounded to 1 350 m. Note that when the slope of the approach surface changes (e.g. where the operations have an angle above 3.0°), the formula above gives different result and the length needs to adapt accordingly, hence footnote b.

4.2.4 Inner transitional surfaces

Note.— The inner transitional surfaces aim at establishing the airspace to be maintained free from fixed and mobile obstacles to protect an aeroplane in the climb phase of the balked landing or late go-around manoeuvres following a standard 3.0° approach, beyond the inner approach surface. See Figure 4-2 and Figure 4-3.

Origin:	*Rationale*
OLSTF/24 ADOP/4	The note provides the specific operational objective of the inner transitional surfaces, which is the protection of aeroplanes during late go-arounds and balked landing manoeuvres initiated during a straight-in approach following the standard 3.0° slope. The inner transitional surfaces protect aircraft past the inner edge of the inner approach surface. They cover the end of the descent phase beyond the inner edge of the inner approach surface and the climb phase manoeuvres.

4.2.4.1 *Description.— Inner transitional surfaces:*

a) *Non-instrument and non-precision approach runways* — A complex surface at a specified distance from the runway centre line consisting of two successive sections: a first section that rises vertically to a given height, followed by a second inclined section that slopes upwards and outwards to a specified height; and

b) *Precision approach runways* — A surface similar to the transitional surface but closer to the runway.

Origin:
OLSTF/24
ADOP/4

Rationale

<u>Non-instrument runways and non-precision approach runways</u>

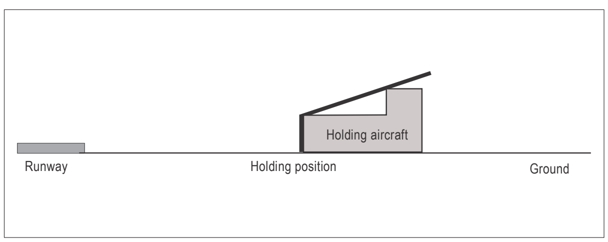
On these runways, the inner transitional surfaces are newly introduced. Hence, they have to be compliant with the existing environment and not impose unnecessary constraints. For example, the surfaces should not introduce new restrictions on aircraft and vehicles at holding positions as this would result in reduced runway capacity and other financial implications.

The inner transitional surface intends to limit mobile objects, in addition to fixed objects, along the runway. The principle considered in designing the surface ensures that the impact posed by a proposed mobile object will not be greater than the impact of having vehicles and aircraft currently at the runway holding positions. In order not to impact existing provisions, the surface is designed to start at the holding position. This ensures the mobile objects are limited to the same requirements as aircraft and vehicles at the holding positions.

Since the surface needs to start at the runway holding position, right before the point where the nose of the aircraft may be located, the surface needs to rise vertically to reach the nose height.

The surface is also intended to preserve aeroplanes on balked landing manoeuvres (where they may diverge laterally during their climb). Hence, the second segment of the surface slopes upwards and outwards, which is similar to the inner transitional surface applicable to precision approach runways.

Consequently, the design of the inner transitional surfaces should follow the shape illustrated below, with a vertical section followed by an inclined one.



<u>Precision approach runways</u>

On precision approach runways, the inner approach, inner transitional and balked landing surfaces remain similar to the current surfaces, except for slight changes to its dimension (see the rationale box associated with Tables 4-4, 4-5 and 4-6) which will not affect the general shape of the surfaces.

Hence, on precision approach, the description of the inner transitional surface does not change.

4.2.4.2 *Characteristics.*— On non-instrument and non-precision approach runways:

a) the limits of the vertical section of the inner transitional surface shall comprise:

1) a lower edge beginning on the side of the inner approach surface at a specified height above the inner edge of that surface, extending down the side of the inner approach surface to its inner edge, from there along a line parallel to and at a specified distance from the runway centre line,

and its extension, to a specified length after the threshold and from there, vertically to a specific height; and

2) an upper edge parallel to, and at a specified height above, the runway centre line;

b) the limits of the inclined section of the inner transitional surface shall comprise:

1) a lower edge beginning at the end of the inner approach surface and extending down the side of the inner approach surface to the upper edge of the vertical section, from there along the upper edge of the vertical section; and

2) an upper edge parallel to and at 60 m above the elevation of the highest threshold of the runway.

4.2.4.3 *Characteristics.—* On precision approach runways, the limits of the 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 a line parallel to and at a specified distance from the runway centre line and its extension to the inner edge of the balked landing surface and from there up the side of the balked landing surface to the upper edge; and

b) an upper edge located at 60 m above the elevation of the highest threshold of the runway.

Origin: OLSTF/24 ADOP/4	*Rationale* As the shape of the inner transitional surface is different for non-precision and non-instrument runways from that of precision approach runways, separate characteristics must be specified. <u>Non-instrument and non-precision approach runways</u> The characteristics address both the vertical section and inclined section of the inner transitional surfaces. For each section, the lower edge (similar to the current description of the inner transitional surface) and upper edge of the section are presented. The height of the upper edge of the inclined section is fixed at 60 m in order to be consistent with the height of the inner transitional surface on precision approach runways. <u>Precision approach runways</u> The characteristics are similar to those of the current inner transitional surface, except for the height of the surface. As described in the rationale box associated with Tables 4-3, 4-4 and 4-5, the height of the balked landing is increased to 60 m. A corresponding change is done for the inner transitional surface. The inner approach is designed up to a height of 45 m.

4.2.4.4 On non-instrument and non-precision approach runways, the elevation of a point shall be:

a) on the lower edge of the vertical section:

1) along the side of the inner approach surface — equal to the elevation of the inner approach surface at that point; and

2) after the inner edge of the inner approach surface — equal to the elevation of the nearest point on the centre line of the runway or its extension;

b) on the upper edge of the vertical section — equal to a specific height above the nearest point on the centre line of the runway or its extension;

c) on the lower edge of the inclined section:

1) along the side of the inner approach surface — equal to the elevation of the inner approach surface at that point; and

2) along the upper edge of the lower section — equal to the elevation of the upper edge of the lower section at that point.

Note.— As a result of a), b) and c) the two sections of the inner transitional surfaces along the centre line of the runway will be curved if the runway profile is curved, or a plane if the runway profile is a straight line. The upper edges of both sections of the inner transitional surfaces will also be curved or straight lines depending on the runway profile.

4.2.4.5 On precision approach runways, 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 runway centre line and its extension — 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 surfaces along the centre line of the runway will be curved if the runway profile is curved, or a plane if the runway profile is a straight line. The upper edge of the inner transitional surfaces will also be a curved or a straight line depending on the runway profile.

Origin: OLSTF/24 ADOP/4	*Rationale* As the shape of the inner transitional surface is different for non-precision and non-instrument runways from that of precision approach runways, the elevation of points on the surfaces should be identified separately. <u>Non-instrument and non-precision approach runways</u> The elevation of a point shall be described on the contour of the lower vertical section (i.e. the lower and upper edges) and on the lower edge of the inclined section. However, the elevation does not need to be specified on the upper edge of the inclined section as this height is already specified in the characteristics of the surface, i.e. 60 m. <u>Precision approach runways</u> The shape of the inner approach surface on precision approach runways being similar to the current situation, the elevation on the lower edge remains as existing. In addition, the elevation does not need to be specified on the upper edge of the surface as this height is already specified in the characteristics of the surface.

4.2.4.6 The slope of the inner transitional surfaces shall be measured:

a) between the inner edges of the inner approach surface and balked landing surface: in a vertical plane perpendicular to the vertical plane containing the runway centre line and its extension;

b) before the inner edge of the inner approach surface:

1) where straight-in approaches are utilized: in a vertical plane perpendicular to the vertical plane containing the runway centre line and its extension; and

2) where lateral offset, angular offset or curved approaches are utilized: along any straight part of the approach, in a vertical plane perpendicular to the vertical plane containing the straight part of the approach or, along any curved part of the approach, in the vertical plane tangent with the curved ground track.

Origin: OLSTF/24 ADOP/4	*Rationale* The slope of the inner transitional surface needs to be measured above the datum and should be consistent with the trajectories of aircraft. Where the trajectories are straight or curved, the way to measure the slope is slightly different.

4.2.4.7 The slope of the inner transitional surfaces for non-instrument runway shall not be greater than, and the height of the vertical section not lower than, that specified in Table 4-6.

4.2.4.8 The slope of the inner transitional surfaces for non-precision approach runway shall not be greater than, and the height of the vertical section not lower than, that specified in Table 4-7.

4.2.4.9 The slope of the inner transitional surfaces for precision runway shall not be greater than that specified in Table 4-8.

Table 4-6. Dimensions of inner transitional surfaces — Non-instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Height of the vertical section	6 m	6 m	1.7 m	5 m	5 m	5 m
Slope of the inclined section	40 %	40 %	33.3%	33.3%	33.3%	33.3%
Length	a	a	1 800 m[b]	1 800 m[b]	1 800 m[b]	1 800 m[b]

[a] To the end of the strip.
[b] Or to the end of the runway, whichever is less.

Table 4-7. Dimensions of inner transitional surfaces — Non-precision approach runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Height of the vertical section	6 m	6 m	5 m	5 m	5 m	5 m
Slope of the inclined section	40 %	40 %	33.3%	33.3%	33.3%	33.3%
Length	a	a	1 800 m[b]	1 800 m[b]	1 800 m[b]	1 800 m[b]

[a] To the end of the strip.
[b] Or to the end of the runway, whichever is less.

Table 4-8. Slopes of inner transitional surfaces — Precision approach runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Slope	40 %	40 %	33.3%	33.3%	33.3%	33.3%
Length	a	a	a	a	a	a

[a] See 4.2.4.3.

Origin:
OLSTF/24,
ADOP/4

Rationale

On non-instrument and non-precision approach runways: Table 4-6 and Table 4-7

The inner transitional surface is specified to:

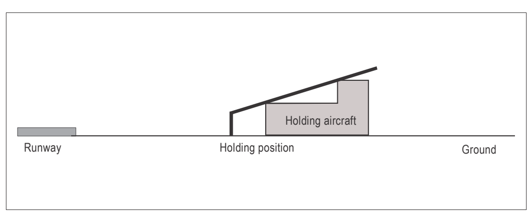
a) accommodate aircraft and vehicles at runway holding positions as being allowed for decades with no safety case, hence, they should be considered safe for approach and go-arounds operations; and

b) limit the size of mobile objects below the surface. At holding positions, the surface is such that the highest obstacles should not be greater than the most demanding aircraft that the considered runway is intended to accommodate, in order to prevent extremely high obstacles in close proximity of the runway; and

c) ensure the safety of aircraft in late go-arounds and balked landing manoeuvres.

Shape of the surface

The first and second points above affect the shape of the inner transitional surface on non-precision and non-instrument runways. The transitional surface should be such that a holding aircraft would fit under the surface, preventing the need for a displacement of the holding positions. The following shape is favoured, as it complies with holding positions and limit the size of obstacles below the surface.



Slope of the surface

Item c) above has a direct implication on the slope of the inner transitional surface. Considering that:

a) the current slope of the inner transitional surface on precision runways is satisfactory to ensure the protection of aircraft on go-arounds following a precision approach; and

b) aircraft on late go-arounds and balked landing following non-precision and non-instrument approaches benefit from visibility and performances that are at least equal to (if not better than) those of aircraft following precision approaches;

the slope applicable to precision runways should be safe for non-precision and non-instrument approaches.

Hence, the slope of the inner transitional surface is derived from the existing slopes of the inner transitional surface on precision runways.

Type of runway	**ADG I**	**ADG IIA**	**ADG IIB**	**ADG IIC**	**ADG III**	**ADG IV**	**ADG V**
All runways	40 %	40 %	40 %	33.3 %	33.3 %	33.3 %	33.3 %

Origin of the inner transitional surface

The distance between the inner edge of the inner transitional surface and the centre line should be such that on non-precision and non-instrument runways the distance between the inner edges of the inner transitional surfaces on each side of the runway centre line should not be longer than**:**

a) the distance between the holding positions and the centre line of the runway as the inner transitional surface should not affect holding positions;

b) half the minimum length of the inner edge of the approach surface (on all runway widths) as the inner transitional surface must not limit obstacles where they are allowed as per the transitional surfaces which starts at the end of the approach surface. This is the reason why the distance between the inner edge of the inner transitional surface on non-instrument runways of ADG IIC is 50 m;

c) half the inner edge of the inner approach surface on precision runways as the inner transitional surface should not be more conservative on non-precision and non-instrument runways than on precision approach runways.

Height of the vertical step on non-instrument and non-precision approach runways

The height of the vertical step of the inner transitional surface on non-precision and non-instrument runways is specified in such a way that the inner transitional surface is tangent to the nose of the critical aeroplane intended on the considered runway. The dimensions of critical aeroplane provided in Annex 14, Volume I (ninth edition), for the design of the inner transitional surface on precision runways (see Chapter 3, Table 3-1), when converted to ADG categorization are as follows:

	ADG I-IIB	**ADG IIC-IV**	**ADG V**
Nose height	5.2 m	10m	10 m
Tail height	8 m	20 m	24 m
Distance from the nose to the highest part of the tail	24.6 m	52.7 m	62.2 m

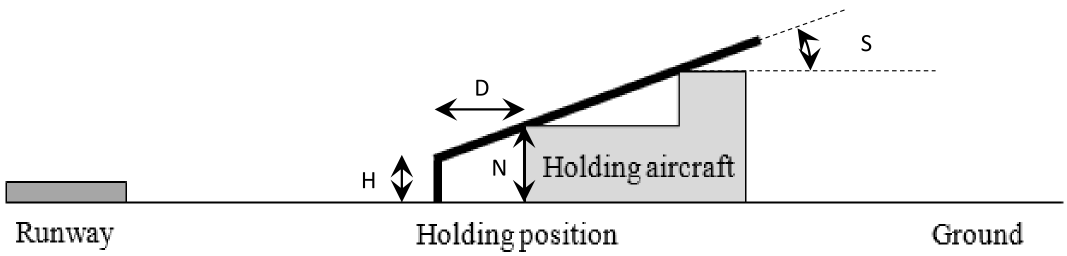
Dimensions of the critical aeroplane at holding position (related to ADG)

Note. — The value of 1.7m in Table 4-6 was arrived at, taking into consideration the location of the runway holding position, width of the approach surface, *nose height of the aircraft and distance between the nose and the highest part of the tail for aircraft with ADG IIC.*

In this case, the height H of the vertical step should be such that it verifies the following formula:

$$H+D/S=N, \text{ or } H=N-D/S$$

With the distance *D* between the holding position and the vertical step, the nose height *N* of the critical aeroplane at the holding position, and the slope *s* of the inner transitional surface.



Type of runway	ADG I	ADG IIA	ADG IIB	ADG IIC	ADG III	ADG IV	ADG V
Non-instrument	*30 m*	*40 m*	*40 m*	50 m	60 m	60 m	60 m
Non-precision	*40 m*	*40 m*	*40 m*	60 m	60 m	60 m	60 m
Precision	*45 m*	*45 m*	*45 m*	*60 m*	*60 m*	*60 m*	*60 m*

Precision approach runways (Table 4-8)

The inner transitional surface remains identical to the existing surface for precision approach runways. This implies that only the slope needs to be specified in a table as there is no vertical step and the length is dictated by the position of the balked landing surface.

The existing slopes based on ARC are transposed to the proposed classification of aeroplane design group, resulting in Table 4-8.

4.2.5 Balked landing surface

Note.— The balked landing surface is intended to be implemented on precision approach runways, where the balked landing might be initiated at low height above the threshold and the climb phase of the manoeuvre is not necessarily covered by the inner transitional surfaces. The balked landing surface aims at establishing the airspace to be maintained free from fixed and mobile obstacles to protect an aeroplane in the climb phase of the balked landing or late go-around manoeuvres following a standard 3.0° approach, beyond the inner transitional surfaces. See Figure 4-3.

Origin: OLSTF/24 ADOP/4	*Rationale* The balked landing surface is intended for the protection of go-arounds and balked landing manoeuvres past the end of the inner transitional surfaces, where aircraft may still fly at low heights and require additional protection from mobile objects. On non-instrument and non-precision approach runways, the minima are higher than 75 m (250 ft) and the pilots are in a position to see obstacles from this height above the aerodrome

	elevation. Hence, even considering: a) a conservative time of 6 s between the minima and the initiation of the go-around. This reaction time is generally retained in the approach phase but is conservative with regards to the time of 3 s retained for the initiation of the missed approach, see PANS-OPS, Volume II, Part I, Section 2, Chapter 3, Table I-2-3-1); and b) the time of 9 s considered necessary by the OCP for an aircraft to recover a positive climb rate (in order to be conservative, for this time, the aircraft is supposed to maintain the descent angle of 3.0°), the pilot would have enough time to initiate a go-around from a sufficient height to avoid typical mobile objects around the runway.

4.2.5.1 *Description.— Balked landing surface*. An inclined surface located at a specified distance after the threshold, extending between the inner transitional surfaces.

4.2.5.2 *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 located 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 at 60 m above the elevation of the highest threshold of the runway.

4.2.5.3 The elevation of the inner edge shall be equal to the elevation of the nearest point on the runway centre line.

4.2.5.4 The slope of the balked landing surface shall be measured in the vertical plane containing the centre line of the runway and its extension;

4.2.5.5 The slope of the balked landing surface shall not be greater than, and its other dimensions not less than, those specified in Table 4-9.

Table 4-9. Dimensions and slopes of balked landing surface

Aeroplane design group	**I**	**IIA-IIB**	**IIC**	**III**	**IV**	**V**
Distance from threshold	a	a	1 800 m[b]	1 800 m[b]	1 800 m[b]	1 800 m[b]
Length of inner edge	90 m	90 m	120 m	120 m	120 m	120 m[d]
Divergence (each side)	10%	10%	10%	10%	10%	10%
Slope	5%	4%	3.33%	3.33%	3.33%	3.33%

a. End of the strip.
b. Or end of runway whichever is less.
c. The width is increased to 140 m on those aerodromes that accommodate a code letter F aeroplane that is not equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre.

Origin: OLSTF/24 ADOP/4	*Rationale* The description, characteristics and dimensions of the balked landing surface are maintained as existing, except for the following minor changes. a) the height of the surface is increased to 60 m in order to improve the accessibility of runways with CAT II minima for CAT III approaches (see the rationale box associated with Tables 4-3, 4-4 and 4-5, and the specifications concerning precision approach runways); and b) the vertical datum taken as reference (see the rationale box associated with 4.2.2.2).

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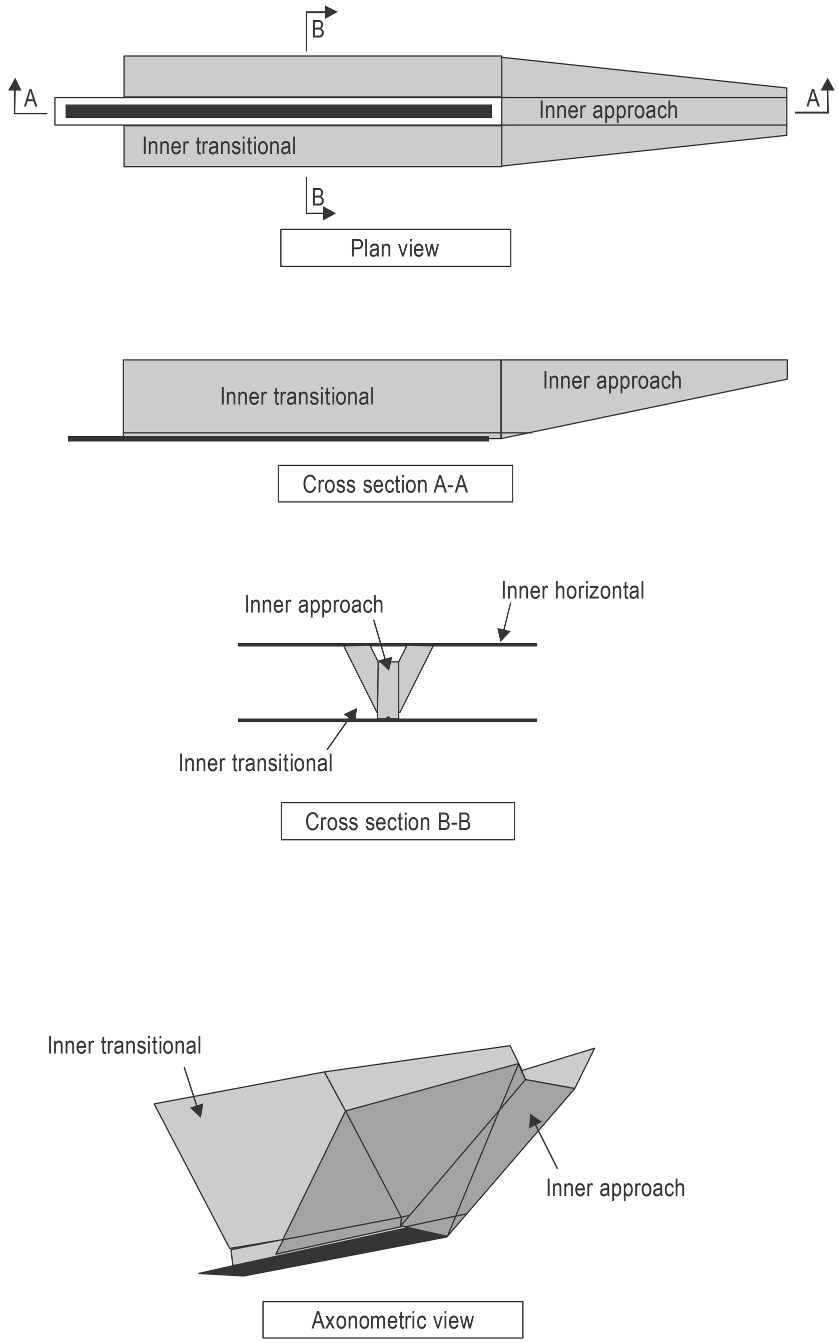

Figure 4-2. Inner approach and inner transitional surfaces on a non-precision approach runway

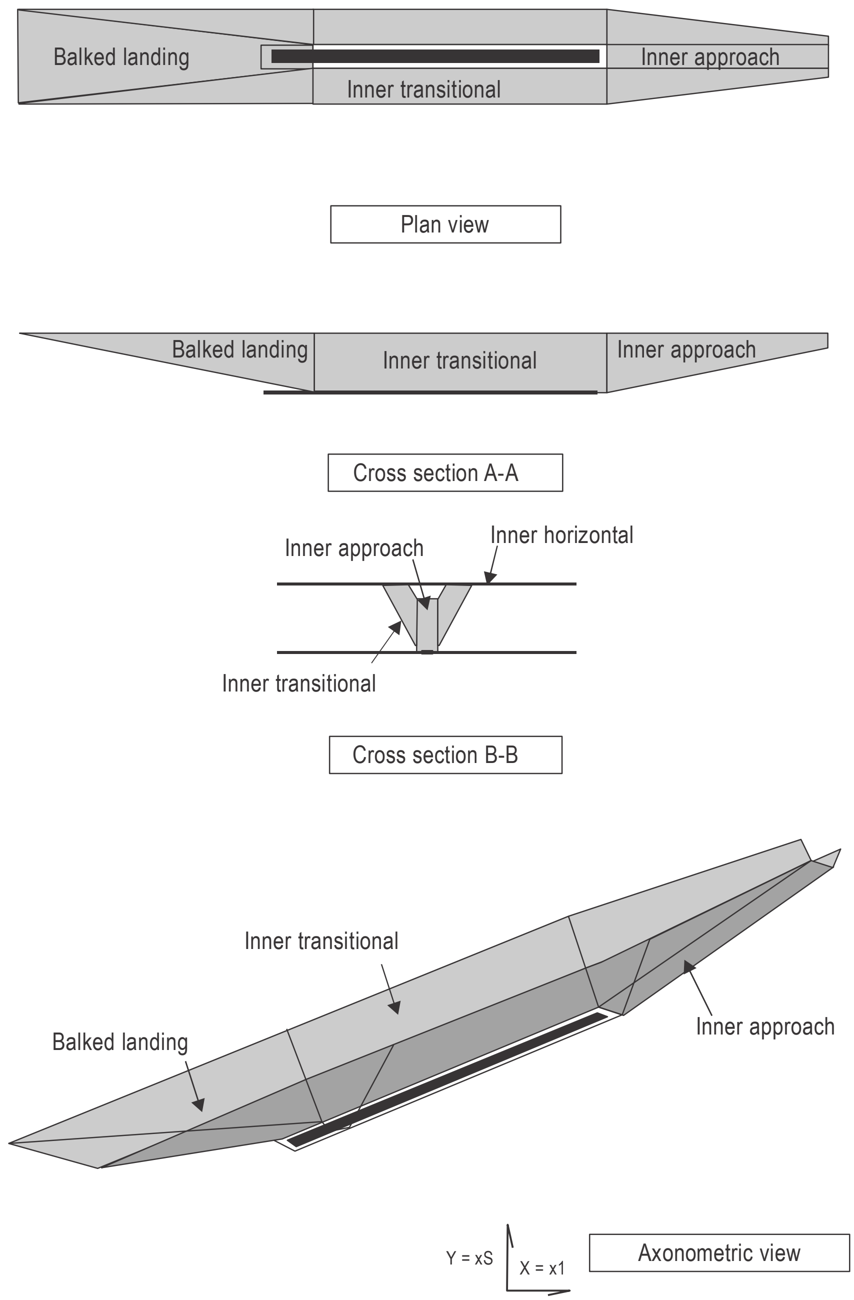

Figure 4-3. Obstacle free zone on a precision approach runway

4.2.6 Take-off climb surface

Note 1.— The purpose of the take-off climb surface is to establish the volume of airspace where obstacles may have an impact on aircraft operating limitations during take-off under non-critical operating conditions. The design of the take-off climb surface is consistent with the take-off obstacle clearance limitations provided in the Aeroplane Performance Manual *(Doc 10064, Chapter 3), and Annex 6, Part I.*

Note 2.— Obstacles that have no impact on aircraft operating limitations during take-off under non-critical operating conditions could have an impact in case of engine failure or abnormal (e.g. extreme weather conditions) and emergency situations (e.g. system failure).

Origin: OLSTF/27 ADOP/4	*Rationale* The accessibility of aerodromes may be limited by obstacles affecting approach operations, and take-off climbs. Hence, the identification of obstacles that could impact take-off operations is necessary and a dedicated surface should be established. The take-off climb performances of aircraft may be highly different at aerodromes. The variability of the climb performances is linked to a series of parameters (e.g. mass of the aeroplane, air temperature, wind, runway slope, aerodrome elevation). Having a fixed slope could be over-conservative for some aerodromes. Hence, the slope of the take-off climb surface should be made adjustable based on the operational characteristics of aeroplane operating at the aerodrome and the local conditions. When changing the slope of the take-off climb surfaces, it is important for airlines and pilots to be consulted, as it may affect payload and will affect airlines' profit margin. It is the pilot's responsibility to ensure the safe clearance of obstacles on take-off both during all-engine operations and under OEI conditions. This responsibility is clearly specified in Annex 6 and in Doc 10064, Chapter 3.

4.2.6.1 *Description.— Take-off climb surface.* An inclined surface beyond the end of the take-off distance available.

4.2.6.2 *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 at a specified distance at the end of the take-off distance available;

b) two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the take-off ground 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 take-off track.

4.2.6.3 The above surface shall vary when take-off flight paths involving turns are utilized; two sides originating at the end of the inner edge and diverging uniformly at a specified rate from the extended centre line of the take-off ground track to a specified final width, and extending thereafter parallel to the take-off ground track for the remainder of the length of the take-off climb surface.

Origin: OLSTF /24 ADOP/4	*Rationale* There are no changes to the description and characteristics of take-off climb surface from the current provisions in Chapter 4.

4.2.6.4 The elevation of the inner edge shall be equal to the highest point on the extended runway centre line between the end of the take-off run available and the inner edge of the take-off climb surface.

Origin: OLSTF/24 ADOP/4	*Rationale* The current provisions related to elevation of the inner edge specified in Chapter 4 are as follows: "The elevation of the inner edge shall be equal to the highest point on the extended 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" However, the proposal prefers the use of the terms "end of the take-off distance available" to "the end of the runway", as it is clearer in terms of operational function. Hence, consistently with the use of "take-off run available", the "end of the take-off distance available" is used to replace the end of clearway.

4.2.6.5 The slope of the take-off climb surface shall be measured:

a) in the vertical plane containing the centre line of the runway and its extension where straight take-off flight path are utilized;

b) along any straight part of the take-off flight path, in the vertical plane containing the centre line of the take-off flight path or, along any curved part of the take-off flight path, in the vertical plane tangent with the take-off flight path where take-off flight paths involving turns are utilized.

Origin: OLSTF/24 ADOP/4	*Rationale* The slope for take-off climb surfaces now includes means to measure slopes for curved sections of the flight path in addition to standard straight take-off flight path.

4.2.6.6 **Recommendation.—** *On runways intended for operations of aeroplanes with a maximum certificated take-off mass up to 5 700 kg, the slope of the take-off climb surface should not be greater than, and its other dimensions not less than, those specified in Table 4-10, except that:*

a) a lesser length should be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes; and

b) a higher slope should be adopted for the take-off climb surface where such slope would be consistent with the operational characteristics of the critical aeroplane operating out of the runway and the local conditions.

4.2.6.7 **Recommendation.—** *On runways intended for operations of aeroplanes with a maximum certificated take-off mass greater than 5 700 kg, the slope of the take-off climb surface should not be greater than, and its other dimensions not less than, those specified in Table 4-11, except that:*

a) a lesser length should be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes; and

b) a higher slope should be adopted for the take-off climb surface where such slope would be consistent with the operational characteristics of the critical aeroplane operating out of the runway and the local conditions.

4.2.6.8 **Recommendation.**— *The slope of the take-off climb surface should not be increased to facilitate the growth of obstacles.*

Note.— The slope of the take-off climb surface is intended to adapt to the operations of aeroplanes whose climb performances on take-off climb are such that a slope of 2 per cent is not necessary. However, this slope is not intended to be increased to enable the growth of obstacles. Specifications concerning the increase of the slope of the take-off climb surface are contained in PANS-Aerodromes *(Doc 9981), Part II, Chapter 10.*

4.2.6.9 **Recommendation.—** *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 4-10 and Table 4-11 to 1.6 per cent when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of the take-off climb surface should be made so as to provide protection to a height equal to that reached with the slopes and lengths in Table 4-10 and 4-11.*

Origin: OLSTF/24 ADOP/4	*Rationale* The *Aeroplane Performance Manual* (Doc 10064) was "developed to provide guidance material to support the Standards and Recommended Practices of Annex 6 — *Operation of Aircraft*, Part I, Chapter 5, Aeroplane Performance Operating Limitations" (see Doc 10064, Foreword). Annex 6 applies to the commercial operations, Chapter 5 more specifically to the operations of large aeroplanes certificated in accordance with parts IIIA and IIIB of Annex 8 — *Airworthiness of Aircraft* (i.e. all aeroplanes with a maximum certificated take-off mass greater than 5 700 kg, certificated after 1960). Consequently, the provisions which previously belonged in Annex 6 and provide information on the clearance of obstacles during take-off climb are now found in Doc 10064 and apply to aeroplanes with a maximum certificated take-off mass greater than 5 700 kg operating commercial air transport. The provisions can help designing a take-off climb surface consistent with the specifications related to the clearance of obstacles that large aeroplanes of commercial air transport should respect. Thus, different surfaces can be proposed for runways accommodating: a) commercial air transport operations of large aeroplanes; b) non-commercial air transport operations of large aeroplanes and operations of small aeroplanes. However, in order to provide similar surfaces to similar aircraft; it is proposed that all large aeroplanes share the same surfaces. Hence different surfaces for runways intended for small, and large aeroplanes. Paragraphs 4.2.6.8 and 4.2.6.9 are rewording of the existing provisions in Chapter 4.

Table 4-10. Dimensions of take-off climb surface – runways with operations of aeroplanes with a mass up to 5 700 kg

Aeroplane design group	I	IIA-IIB	IIC[a]	III[a]	IV[a]	V[a]
Distance from TODA[b]	30 m	60 m	-	-	-	-
Length of inner edge	60 m	80 m	-	-	-	-
Divergence (each side)	10%	10%	-	-	-	-
Final width	380 m	580 m	-	-	-	-
Length	1 600 m	2 500 m	-	-	-	-
Slope	5%	4%	-	-	-	-

a. Aeroplanes with a mass up to but not including 5 700 kg generally belong to aeroplane design groups I, IIA and IIB.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.

Origin: OLSTF/24 ADOP/4	*Rationale* On runways accommodating operations of small aeroplanes (i.e. with a maximum certificated take-off mass up to 5 700 kg), the provisions of the Doc 10064 do not apply. For the concerned runways, the current dimensions of the take-off climb surface are maintained. However, they are transposed in the classification on aeroplane design groups. Considering that small aeroplanes (with a maximum certificated take-off mass of 5 700 kg and less) have a wingspan below 24 m (hence belonging to groups I, IIA and IIB), the dimensions associated with code numbers 3 and 4 (or ADG IIC to V) are not necessary.

Table 4-11. Dimensions of take-off climb surface – runways with operations of aeroplanes with a mass above 5 700 kg

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Distance from TODA	-	-	-	-	-	-
Length of inner edge	144 m	156 m	156 m	172 m	180 m	180 m
Divergence (each side)	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%
Final width	1 800 m [a]	1 800 m [a]	1 800 m [a]	1 800 m [a]	1 800 m [a]	1 800 m [a]
Length	10 000 m	10 000 m	10 000 m	10 000 m	10 000 m	10 000 m
Slope	5%	4%	2%	2%	2%	2%

[a] Where given operational conditions and performances are met, the final width can be decreased. Specifications concerning this reduction are contained in PANS-Aerodromes (Doc 9981), Part II, Chapter 10.

Origin: OLSTF/24 ADOP/4	*Rationale* On runways accommodating operations of large aeroplanes (i.e. with a mass over 5 700 kg), the provisions of the Doc 10064 are retained (see the rationale box associated with 4.3.5.5). Distance from TODA The take-off climb surface should commence at the end of TODA, as the obstacle clearance established in Doc 10064 depends on the "horizontal distance the aeroplane has travelled from the end of take-off distance available" (see Doc 10064, Chapter 3, 3.3.1). Length of inner edge Doc 10064, Chapter 3, 3.3.1 indicates that "No aeroplane should commence a take-off at a mass in excess of that indicated in the flight manual to correspond with a net take-off flight path, which clears all obstacles […] by […] at least 90 m (300 ft) plus 0.125 D laterally, where D is the horizontal distance the aeroplane has travelled from the end of take-off distance available […]. For aeroplanes with a wingspan of less than 60 m (200 ft), a horizontal obstacle clearance of half the aeroplane wingspan plus 60 m (200 ft), plus 0.125D may be used". The previous information indicates that, where the distance from the end of TODA is null (i.e. at the inner edge of the take-off climb surface), obstacle should be at: a) half wingspan plus 60 m of the flight path where aeroplanes have a wingspan below 60 m; and b) 90 m from the flight path where aeroplanes have a wingspan over 60 m. Considering the wingspans of the proposed aeroplane design groups, the above gives an inner edge of: — 2*12+2*60 = 144 m where the wingspan is 24 m, for ADG I; — 2*18+2*60 = 156 m where the wingspan is 24 m, for ADG IIA, IIB and IIC; — 2*26+2*60 = 172 m where the wingspan is 52 m, for ADG III; — 2*90 = 180 m where the wingspan is 60 m and more, for ADG IV and V. Divergence Considering the citation from Doc 10064, Chapter 3, 3.3.1, the divergence should be 12.5 per cent on each side of the take-off flight path. Final width Doc 10064, Chapter 3, 3.3.2 indicates that "Different horizontal distances on either side of the intended track, up to which obstacle clearance has to be ensured, may apply. For visual meteorological conditions (VMC) by day, obstacles should be considered if their distance from the intended track is within 300 m (1000 ft) for track changes of less than 15 degrees, and 600 m (2000 ft) for track changes of more than 15 degrees. For operations conducted in IMC, or VMC by night, obstacles should be considered if their distance from the intended track is within 900 m (3000 ft) for track changes of less than 15 degrees. Obstacles at a distance greater than 900 m (3000 ft) on either side of the intended track need not be cleared"

	In addition, 3.3.1 indicates “Obstacles at a distance greater than 300 m (1000 ft) and 600 m (2000 ft) on either side of the intended track need not be cleared if the navigation system under one engine inoperative (OEI) conditions provides a two standard deviation accuracy of 150 m (500 ft) and 300 m (1 000 ft) respective”. The previous paragraphs imply the following widths: — 600 m where operations are conducted: o in VMC by day and track changes of less than 15 degrees; or o with the navigation system under one engine inoperative (OEI) conditions providing a two standard deviation accuracy of 150 m (500 ft); — 1200 m where operations are conducted: o in VMC by day and track changes of more than 15°; o with the navigation system under one engine inoperative (OEI) conditions providing a two standard deviation accuracy of 300 m (1000 ft); — 1800 m in other cases. Length As per Annex 4, Chapter 3, the Type A chart (or Aerodrome Obstacle Chart) “shall provide the data necessary to enable an operator to comply with the operating limitations of Annex 6, Part I, Chapter 5”. The chart represents all obstacles below the take-off flight path. As the design of the take-off climb surface applicable to runways accommodating large aeroplanes is derived from the provisions in Annex 6, Part I, Chapter 5 with Doc 10064 as a supplement, the OLSTF proposed that the length of the surface should be consistent with that of the Type A chart. In Annex 4, Chapter 3, 3.5.1 states that the Type A chart shall “depict a plan and profile of each runway, […] the take-off flight path area and obstacles.” Paragraph 3.8.2c) continues to state that the take-off flight path “extends to the point beyond which no obstacles exist or to a distance of 10.0 km (5.4 NM), whichever is the lesser”. Hence, the OLSTF proposes a length of 10 000 m. With reference to Annex 4, Chapter 3, 3.5.1 and 3.8.2c) the slope of the take-off climb surface implicitly acknowledges that aeroplane on take-off climb have climb rates higher than 2 per cent. Combined with climb rates over 2 per cent (see below), the length of 10 000 m establishes a volume of airspace where obstacles are identified below the flight path, from the end of the TODA to the point where aircraft reach a height greater than 200 m. This height is conservative in comparison with that covered by approach and transitional surfaces (150 m).

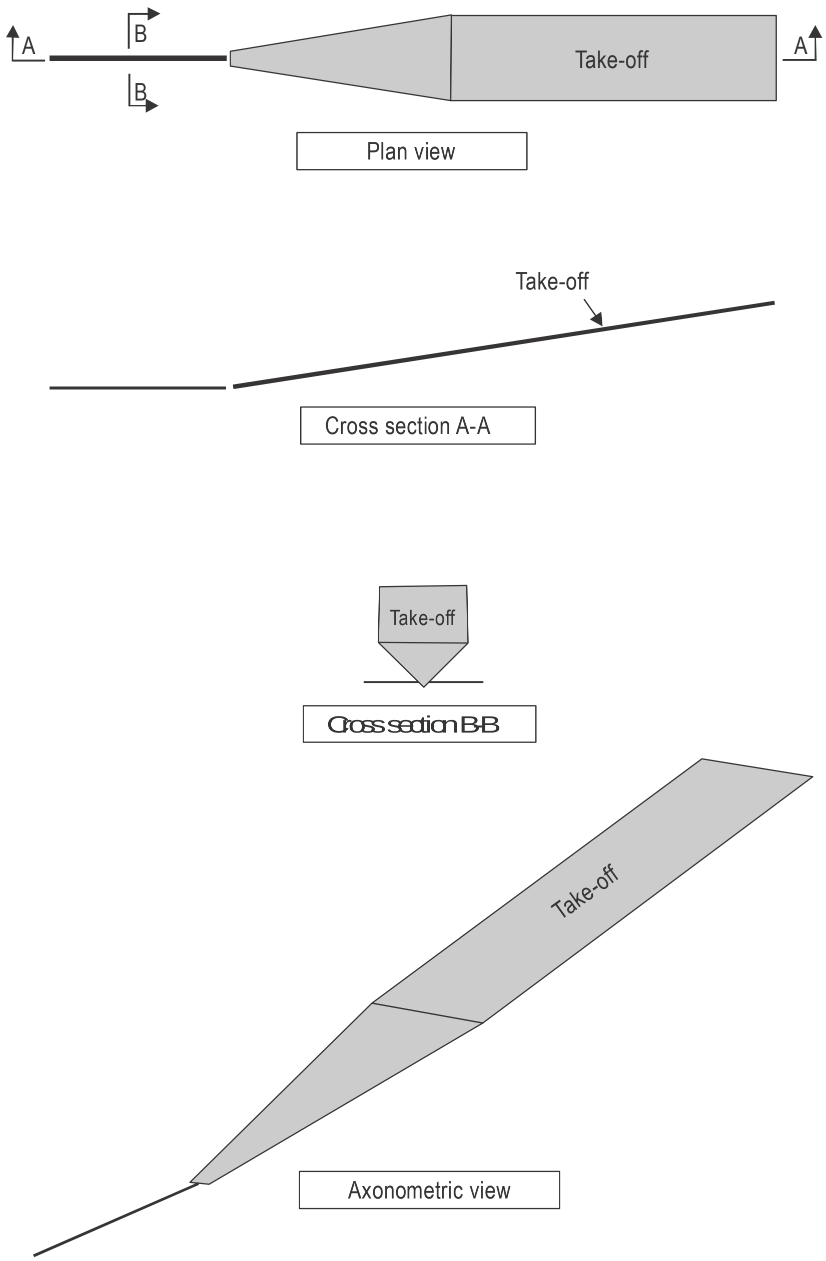

Figure 4-4 Take-off climb surface

4.3 Obstacle evaluation surfaces (OES)

Note 1.— The purpose of the obstacle evaluation surfaces is to establish the volume of airspace necessary to determine the acceptability of obstacles by evaluating their impact on existing and/or intended aeroplane operations at an aerodrome. The impact is evaluated on safety, regularity and demand of the operations identified by States.

Note 2.— The OES detailed in the following specifications address most common flight operations and operating minima. Depending on the flight operations and procedures available at an aerodrome, the OES may have specifications as specified in the following provisions or may be varied to fit the operations at the aerodrome (e.g. in case of increased minima or where circling does not occur on one side of the runway). There will be instances where additional obstacle evaluation surfaces, beyond what are specified in this section, may be required as the OES or its variations do not satisfactorily cover the local aeroplane operations specific to the aerodrome.

Note 3.— Detailed specifications on the variation of the OES and their design are contained in PANS-Aerodromes (Doc 9981).

Origin: OLSTF/24, ADOP/4	*Rationale* Note 1 presents the high-level objective of the obstacle evaluation surfaces. The OES aims at establishing the volume of airspace where obstacles may affect the intended operations at the aerodrome. The impact of obstacle(s) needs to be evaluated in order for the authority to take a decision on the acceptability of the obstacle, depending on their impact on the operations. Note 2 explains the nature of the OLS whose shape and dimensions may vary between aerodromes and the impact of obstacles penetrating the surfaces may differ. The surfaces used to evaluate the impact of obstacles should ideally take into consideration the local operations, as they may differ from one aerodrome to another. In fact, OES of standard shape and dimensions wider than needed would trigger unnecessary aeronautical studies associated with obstacles infringing the OES while having no impact on the operations. In contrast, where the surfaces would be smaller than necessary, there would be obstacles that would not be accounted for and will affect operations and insufficiently preserve the accessibility of aerodromes. Defining the right dimensions for the OES is key in ensuring safety and accessibility without causing unnecessary aeronautical studies. In order to ease the implementation of OES where the expertise necessary for tailoring these surfaces to the operations is not available or implemented, standard OES is proposed. These OES are designed to match the airspace where obstacles may affect the most common types of operations. However, these OES rely on operational hypothesis and may be over-conservative or under-conservative where the operations differ. The OES can have the shape and dimensions of the surfaces described in 4.3.1 to 4.3.5. However, the shape and dimensions may be varied where needed, for example where the operations associated with one surface: a) do not require the whole surface (e.g. when circling occurs on one side of the runway only, a part of the horizontal surface can be removed); or

	b) have different minima from those retained for the design of the surface (e.g. when the circling minima are higher from those retained for the design of the horizontal surface, the height of the surface can be increased); or c) have different performances from those retained for the design of the surface (e.g. when the take-off flight climb rates are higher than those retained for the design of the instrument departure surface). Eventually, where the simple modification of the surfaces described in 4.3.1 to 4.3.5 is not sufficient to comply with the operations intended at the aerodrome, tailored OES can be specified to match the operational needs. This could be the case, for example, where an instrument approach procedure is not safeguarded by the OES specified in 4.3.1 to 4.3.5.

4.3.1 General

4.3.1.1 **Recommendation.—** *States should ensure that the obstacle evaluation surfaces specified in 4.5.2 or parts thereof have been established to protect the existing and/or intended aeroplane operations at an aerodrome.*

4.3.1.2 **Recommendation.—** *The characteristics and dimensions of the obstacle evaluation surfaces should be in accordance with the provisions contained in 4.3.2 to 4.3.5.*

4.3.1.3 **Recommendation.—** *Where the obstacle evaluation surfaces specified in 4.3.2 to 4.3.5 do not adequately protect flight operations at an aerodrome, specific obstacle evaluation surfaces should be established to safeguard these operations.*

Note.— The OES specified in paragraphs 4.3.2 to 4.3.5 have standard dimensions based on typical flight operations (e.g. circling/precision/instrument approaches). When the flight operations differ (e.g. variance in alignment, approach slope, approach minima) these standard dimensions may not protect those operations, hence, specific obstacle evaluation surfaces may need to be established.

Origin: OLSTF/24, ADOP/4	*Rationale* The obstacle evaluation surfaces specified in 4.3.2 to 4.3.5 are based on typical flight operations, namely: a) circling approaches; b) precision approaches; c) other instrument approaches; and d) instrument departures; The flight operations at aerodromes may differ (e.g. alignment, approach slopes and approach minima), therefore the standard OES may not be suitable for the design considerations of the OES. To safeguard all relevant flight operations at an aerodrome, OES varying from the standard OES may be required. It is recommended to establish such specific OES whenever deemed necessary. The specific OES should be based on the requirements of the relevant flight operation, which in most cases would be the criteria as described in PANS-OPS (Doc 8168) or the

	Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual (Doc 9905).

4.3.1.4 **Recommendation..**— *Where it is necessary to preserve the accessibility of an aerodrome to existing and planned operations, the provisions applicable to OFS contained in 4.4.4 to 4.4.8 should apply to the identified obstacle evaluation surface.*

Note.— Detailed specifications are contained in PANS-Aerodromes (Doc 9981), Part II, Chapter 10.

Origin: OLSTF/24, ADOP/4	*Rationale* Where certain operations are critical for the accessibility of a runway, it may be required to strictly limit the possible development of obstacles to ensure the accessibility of the runway and prevent unnecessary efforts in the conduct of aeronautical studies. For instance, at aerodromes served by rare approach procedures, where the accessibility of the runway is highly dependent on the associated operations and limiting obstacles impacting these operations, and a strict limitation of obstacles would be preferred instead of evaluating them.

4.3.2 Horizontal surface

Note.— The purpose of the horizontal surface is to protect the airspace for circling procedures. The horizontal surface also provides some protection for visual circuits and terminal instrument flight procedures, including PBN approaches, early turning missed approaches and early turning departures. The design of the horizontal surface is consistent with the dimensions of the visual manoeuvring area provided in PANS-OPS, (Doc 8168, Volume II, Part 1, Section 4, Chapter 7).

Origin: OLSTF/24, ADOP/4	*Rationale* The horizontal surface is intended to establish the volume of airspace where obstacles may have an impact on visual circling. This objective is similar to current inner horizontal surfaces which, together with the conical surface, “protect airspace for visual circling prior to landing”. Even though the primary objective of the horizontal OES is to safeguard circling or circuit operations, due to its extensive dimension, the surface also contributes to safeguarding the airspace against obstacle that may have an impact on other visual and instrument flight procedures.

4.3.2.1 *Description.— Horizontal surface*. A surface, or a combination of surfaces, located in a horizontal plane, or in a series of horizontal planes, above an aerodrome and its environs.

Origin: OLSTF/24, ADOP/4	*Rationale* The minimum obstacle clearance (MOC, specified in PANS-OPS) represents the minimum margin between obstacles and the obstacle clearance height (OCH, specified in PANS-OPS). Hence, the height of the horizontal surface should be equal to the height of the OCH of the circling procedure, decreased by the height of the MOC.

	Since the MOC and minimum OCH of the circling procedures depend on the indicated airspeed of aircraft at threshold, the height of the horizontal surface varies between aeroplane design groups. For the horizontal surface to be conservative for all circling approach procedures, the lowest possible OCH and MOC are retained (see PANS-OPS, Volume II, Part I, Section 4, Chapter 7, 7.3).

4.3.2.2 *Characteristics.*— The outer limits of the horizontal surface should be circular arcs centred on runway thresholds joined tangentially by straight lines.

Origin: OLSTF/24, ADOP/4	*Rationale* The characteristics of the surface can only be a recommendation, since the shape of the horizontal surface may be varied to match the operations (e.g. the height could be increased to match OCH higher than those specified in the rationale box associated with Table 4-10, or a part of the surface removed where circling does not happen on one side of the runway). The characteristics above are consistent with the specifications of the visual manoeuvring (circling) area (see PANS-OPS, Volume II, Part I, Section 4, Chapter 7, 7.2.1.1).

4.3.2.3 The height of the horizontal surface shall be measured above the aerodrome elevation.

Origin: OLSTF/24 ADOP/4	*Rationale* The current lack of specific requirement to establish the elevation datum of the inner horizontal surface resulted in varying heights of the inner horizontal surface and conical surface and therefore varying level of protection between aerodromes. From a flight operational perspective, the common reference elevation for circling and circuit operations is the aerodrome elevation. The criteria for visual manoeuvring area in PANS-OPS Volumes I and II is: “obstacle clearance height for a circling approach operation is referenced to the aerodrome elevation”. To harmonize application of the surfaces and to align with the requirement of PANS-OPS the aerodrome elevation should be the elevation datum of the horizontal surface(s).

4.3.2.4 **Recommendation.—** *A horizontal surface should have a radius of not less than, and a height of not greater than, those specified in Table 4-12.*

Origin: OLSTF/24	*Rationale* The characteristics of the surface can only be a recommendation considering that the shape and dimensions of obstacle evaluation surfaces may be varied to match the operations.

Table 4-12. Dimensions of horizontal surface

Aeroplane design group	I-IIA	IIB	IIC	III	IV	V
Radius	3 350 m	5 350 m	10 750 m	10 750 m	10 750 m	10 750 m
Height	45 m	60 m	90 m	90 m	90 m	90 m

Origin: OLSTF/24, ADOP/4	*Rationale* The radius and height of the proposed horizontal surface are specified consistently with the existing provisions in the PANS-OPS. *Radius* The provisions in PANS-OPS, Volume II, Part I, provide the radii in relation with the indicated airspeed at threshold. These values are aligned with the ADG categorisation in Table 4-12. *Height* The possible OCH for circling approach procedures can take many values. In order to be conservative, the minimum value of this OCH is retained. This minimum value depends on the indicated airspeed of aeroplanes at threshold in relation with the associated MOC as per PANS-OPS, Volume II, Part I, Section 4, Chapter 7, Table I-4-7-3. These height values are associated with the aeroplane design group.

Note.— Where a runway is intended for the operations of aeroplanes of different aeroplane design groups, all the horizontal surfaces specified by the radii and heights associated with these groups are retained and the horizontal surface is composed of multiple surfaces located at different heights above the aerodrome elevation.

Origin: OLSTF 24 ADOP/4	*Rationale* Where aeroplanes of different ADG fly the circling approach procedures to the runway, their lowest OCH and MOC may be different. According to Table 4-12, the applicable heights and radii of the associated horizontal surfaces may be different, resulting in a succession of horizontal surfaces of different radii and heights. A particular runway may support operations by aircraft that fall in different ADG. In adopting the horizontal surface, all the relevant dimensions associated with the aircraft in different ADG must be adopted. e.g. on a runway, where aircraft of aeroplane design groups I, IIA, IIB and IIC operate circling approach procedures, the three horizontal surfaces associated with these different groups should apply.

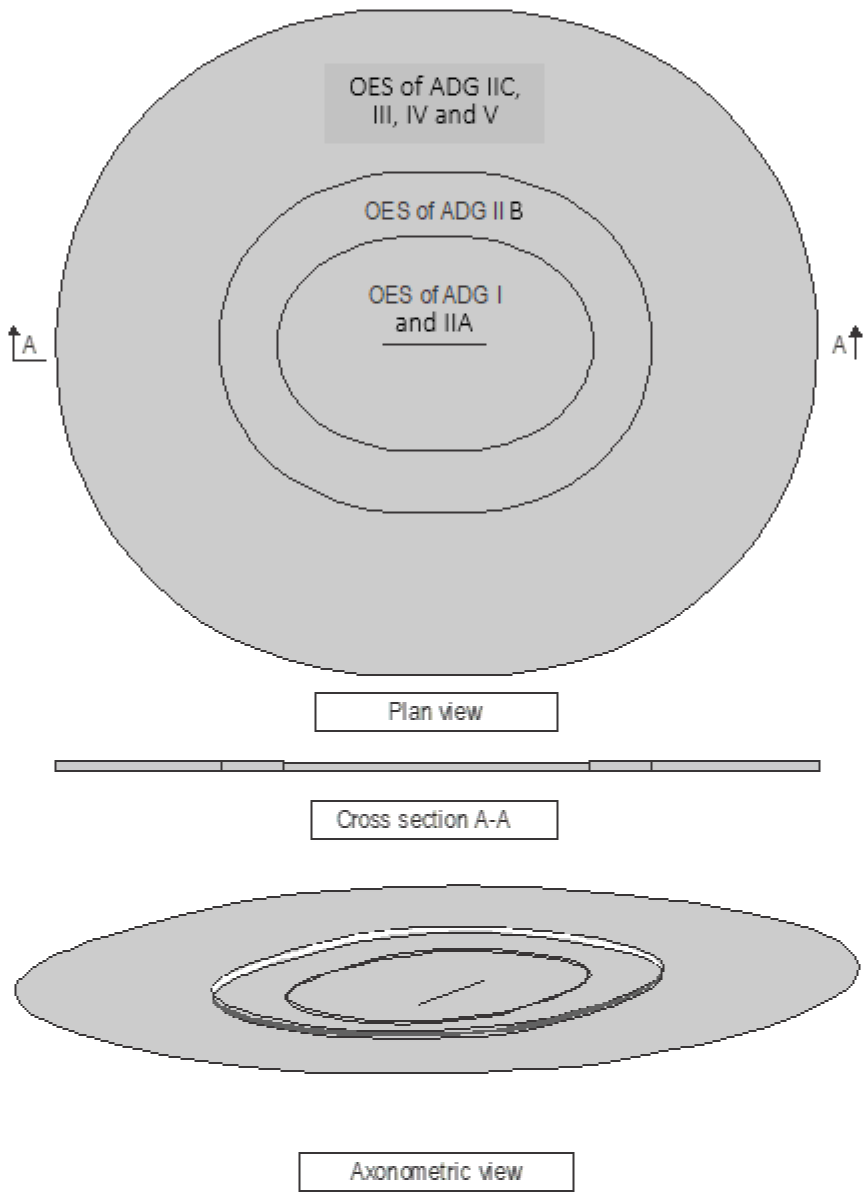

Figure 4-5. Horizontal surface

4.3.3 Surface for straight-in instrument approaches

Note.— The purpose of the surface for straight-in instrument approaches is to establish the volume of airspace where obstacles may have an impact on straight-in instrument approaches, where the horizontal surface(s) or parts thereof are not established. As a single obstacle evaluation surface cannot address the variety of all possible instrument approach procedures, only most common straight-in instrument approaches other than precision approaches are considered. The surfaces for precision approaches is established in 4.3.4.

Origin: OLSTF 24 ADOP/4	*Rationale* The horizontal surface as a plane above the aerodrome and its environs primarily provides some protection for circling approaches. The horizontal surface also provides certain protection for various flight operations at an aerodrome including straight-in instrument approaches and early turning missed approaches. However, the horizontal surface(s) or parts thereof may not be established at an aerodrome and that the horizontal surface, which is based on PANS-OPS criteria for visual manoeuvring areas, may be too conservative to safeguard straight-in approaches. Therefore, it is the purpose of the "surface for straight-in instrument approaches" to establish the volume of airspace where obstacles may have an impact on straight-in instrument approaches, where the horizontal surface(s) or parts thereof are not established. As a single obstacle evaluation surface cannot address the variety of all possible instrument approaches procedures, only most common straight-in instrument approaches are considered, including: — straight in PBN-based instrument approaches; and — VOR approaches. In addition, visual circuits for smaller aircraft are considered, too. Precision approaches as well as straight-in approaches with significant offsets or curved approaches are not considered for the design of the surface for straight-in instrument approaches. Furthermore, low approach minima may not be fully addressed. For precision approaches, dedicated OES are described in 4.3.4. The latter may also be addressed with specific OES as per 4.3.1.

4.3.3.1 *Description.— Surface for straight-in instrument approaches*. A combination of surfaces, located in a series of horizontal planes above an aerodrome and its environs.

4.3.3.2 *Characteristics.—* The surface for straight-in instrument approaches should consist of:

a) a lower part corresponding to the horizontal surface applicable to ADG I;

b) an upper part corresponding to that part of the horizontal surface applicable to ADG II and III extending beyond the lateral limit of the lower section and delineated by the rectangle of following sides:

   1) two shorter sides perpendicular to and centred on the runway centre line and its extension; and

   2) two longer sides extending parallel to the runway centre line and its extension from a given distance before and after the thresholds of the runway.

Note.— The characteristics of the surface for straight-in instrument approaches specified in 4.3.3.2 are applicable to all ADGs.

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<table>
<tr>
<td>Origin:
OLSTF/24
ADOP/4</td>
<td>Rationale

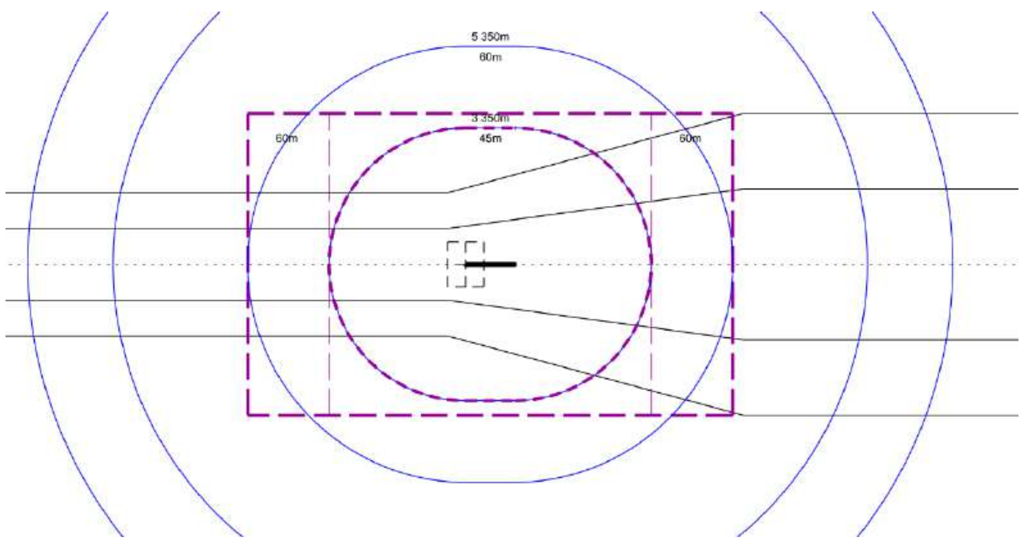
The surface for straight-in instrument approaches is intended to provide some protection for straight-in approaches where the horizontal surface(s) or parts thereof cannot be established.

As a single obstacle evaluation surface cannot address the variety of all possible instrument approaches procedures, a surface to safeguard common procedures is established. For the purpose of harmonization and simple application, the surface for straight-in instrument approaches shall be a part of the horizontal surface.

As the horizontal surface for ADG I would not be sufficient in size for the protection of straight-in instrument approaches, but the lower height of 45 m being beneficial, an additional section is established to cover a larger area but at the height of 60 m as per ADG II.

The following figure compares the horizontal surface with the surface for straight-in instrument approaches.

The size of the upper rectangular section is designed such that common approach procedures are accounted for. For instance, straight-in PBN-based instrument approach procedures are contained in the surface for straight-in instrument approaches as shown in the following figure.



In addition, the surface for straight-in instrument approaches covers visual circuits for smaller aircraft. It becomes particularly relevant when no horizontal surface is established. Notably, at many aerodromes, circling approaches are prohibited and therefore the horizontal surface or parts thereof may not be required to be established – nevertheless, visual circuit pattern especially for smaller aircraft are common operations for which some protection should be provided.

In case lower approach minima are established and are to be protected by OES, specific OES should be established as per 4.3.1.</td>
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4.3.3.3 The heights of the lower section and upper section shall be measured above the aerodrome elevation.

4.3.3.4 **Recommendation.—** *The heights of the surface for straight-in instrument approaches should not be greater than, and its other dimensions not less than, those specified in Table 4-13.*

Table 4-13. Dimensions of surface for straight-in instrument approaches

	Aeroplane design group	I to V
Lower section	**Height**	45 m
	Length	Horizontal OES as per ADG I
Upper section	**Height**	60 m
	Length of shorter side	7 410 m
	Length of longer side from the threshold or thresholds	5 350 m

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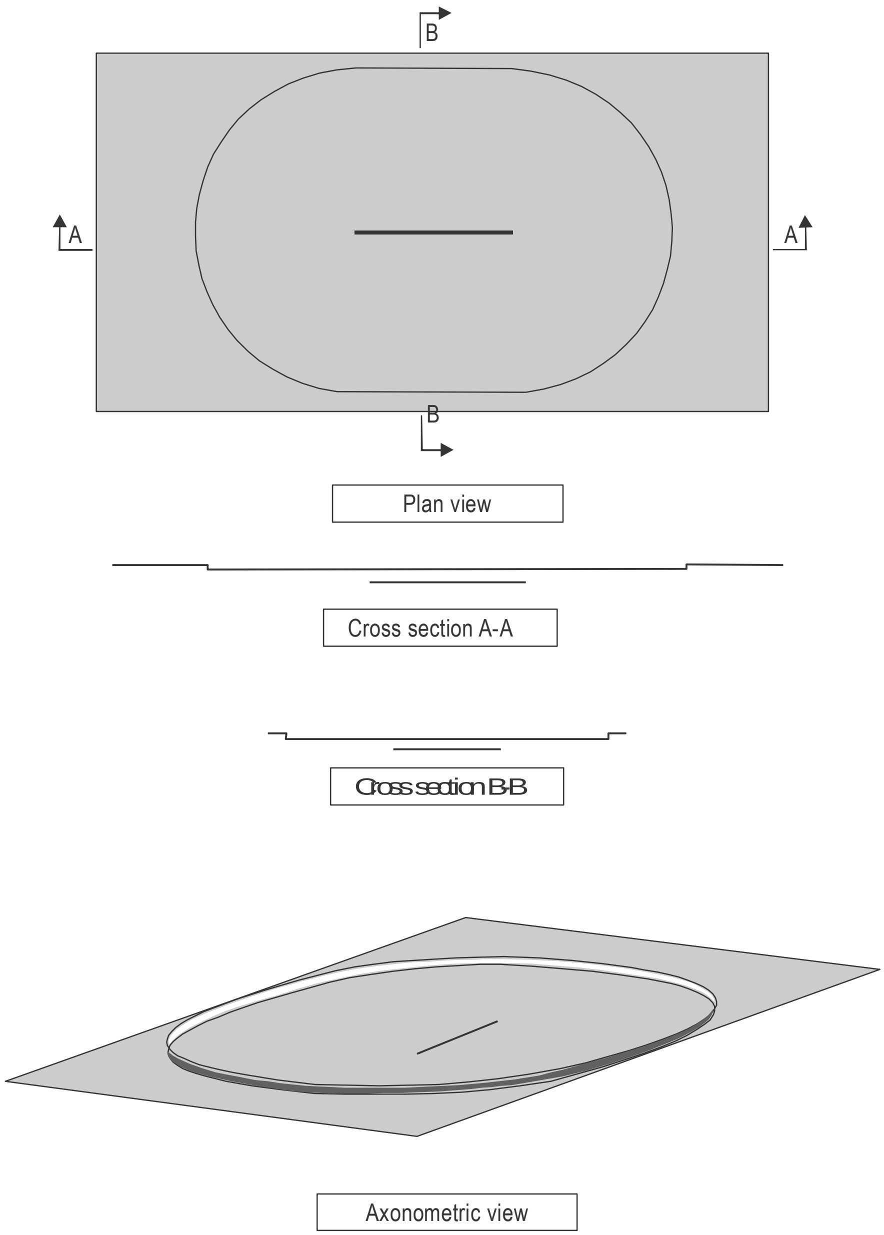

Figure 4-6. Surface for straight-in instrument approaches

4.3.4 Surface for precision approaches

Note.— The purpose of the surface for precision approaches is to establish the volume of airspace where obstacles may have an impact on common straight-in precision approach procedures (using ILS or MLS, ground-based augmentation system *(GBAS) or* satellite-based augmentation system *(SBAS) CAT I). The design of the surface is consistent with the dimensions of the basic ILS surfaces provided in PANS-OPS (Doc 8186) Volume II, Part II, Section I, Chapter 1. Adjustments to the surface may be necessary in case of offset procedures.*

Origin	*Rationale*
OLSTF/24 ADOP/4	The airspaces established by the horizontal surface and the surface for straight-in instrument approaches are not relevant to protect precision approaches as obstacles beyond or below the two surfaces may adversely impact the accessibility of runways for precision approaches. For this reason, an obstacle evaluation surface is necessary to identify obstacles that could affect precision approaches. This surface intends to establish the volume of airspace where obstacles may have an impact on the most common instrument procedures for precision approaches. According to PANS-OPS, precision approaches may be of different types: a) ILS and MLS approaches (relying on ILS and MLS); b) GLS approaches (relying on Ground Based Augmentation System – GBAS); and c) SBAS CAT I (relying on SBAS). The basic ILS surfaces specified in the PANS-OPS establish an adequate airspace for ensuring the accessibility of the runway to ILS, MLS, GLS (and SBAS CAT I) approaches. The use of basic ILS surfaces is the simplest method mentioned in PANS-OPS to be used in calculating OCA/H. As the technical criteria defining the basic ILS surfaces are developed in PANS-OPS, the proposed obstacle evaluation surface is designed accordingly. The surface will be consistent with the obstacle clearance criteria and consequently be efficient to trigger and evaluate obstacles that may affect the operations of precision approaches listed above.

4.3.4.1 *Description.— Surface for precision approaches*. A complex surface composed of:

a) an approach component consisting of an inclined surface preceding the threshold;

b) a missed approach component consisting of an inclined surface located at a specific distance after the threshold;

c) transitional components consisting of complex surfaces at a specified distance from the runway centre line and along the approach component and missed approach component, that slopes upwards and outwards; and

d) a lower component specified by a rectangular surface within the inner edges of the above components.

Note.— The transitional components consist of a pair of surfaces, located on either side of the runway *centre line. Each surface of this pair is called a transitional component.*

Origin: OLSTF/24 ADOP/4	*Rationale* The above description explains the different surfaces which are composed of the following basic ILS surfaces (see PANS-OPS, Volume II, Part II, Section 1, Chapter 1, 1.4.7.2): a) the approach surface becomes the approach component; b) the missed approach surface becomes the missed approach component; c) the extended transitional surfaces become the transitional components; and d) the runway strip becomes the lower component; As the above four together compose of the "surface for precision approaches" the term "surface" used to indicate them individually in PANS-OPS cannot be used again, hence it is termed as "component".

4.3.4.2 *Characteristics.—* The limits of the approach component of the surface for precision approaches should 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 to a specified distance and diverging uniformly thereafter at another specified rate for the remainder of the length of the approach component; and

c) an outer edge parallel to the inner edge.

4.3.4.3 The elevation of the inner edge of the approach component shall be equal to the elevation of the midpoint of the threshold.

4.3.4.4 **Recommendation.—** *The slope of the approach component should be measured in the vertical plane containing the centre line of the runway and its extension.*

4.3.4.5 *Characteristics.—* The limits of the missed approach component of surface for precision approaches should 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 after 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 to a specified distance and diverging uniformly thereafter at another specified rate for the remainder of the length of the missed approach component; and

c) an outer edge parallel to the inner edge.

4.3.4.6 The elevation of the inner edge of the missed approach component shall be equal to the elevation of the midpoint of the threshold.

Note.— In some cases, the inner edge of the missed approach component may be below the elevation *of the midpoint of the threshold, for example where runways slope upward.*

4.3.4.7 **Recommendation.—** *The slope of the missed approach component should be measured in the vertical plane containing the centre line of the runway and its extension*.

4.3.4.8 *Characteristics.—* The limits of the transitional component of the surface for precision approaches should comprise:

a) a lower edge beginning on the side of the approach component at the elevation of the upper edge and extending down the side of the approach component to the inner edge of the approach component, from there along a line extending horizontally to the inner edge of the missed approach component, and from there extending up the side of the missed approach component to the upper edge; and

b) an upper edge located at 300 m above the threshold elevation.

4.3.4.9 The elevation of a point on the lower edge of the transitional component shall be:

a) along the side of the approach component and missed approach component — equal to the elevation of the particular surface at that point; and

b) between the inner edges of the approach component and missed approach component — equal to the elevation of the midpoint of the threshold.

Note.— In some cases, the lower edge of the transitional component may be below the elevation of the midpoint of the threshold, for example where runways slope upward.

4.3.4.10 **Recommendation.—** *The slope of the transitional component should be measured in the vertical plane perpendicular to the centre line of the runway and its extension.*

4.3.4.11 *Characteristics.—* The limits of the lower component of the surface for precision approaches should comprise:

a) two shorter sides corresponding with the inner edge of the approach component and missed approach component; and

b) two longer sides corresponding with the inner edges of the transitional components.

4.3.4.12 The elevation of a point on the lower component shall be equal to the elevation of the midpoint of the threshold.

Origin: OLSTF/24 ADOP/4	*Rationale*
	Characteristics are specified for all the components that make up the surface for precision approaches (hence the points 4.3.4.2, 4.3.4.5, 4.3.4.8 and 4.3.4.11). Considering the possible variation to the surfaces, these characteristics cannot be a Standard. The characteristics of the: — approach component in 4.3.4.2 and missed approach component in 4.3.4.5 are inspired by the characteristics of the approach surface (in 4.2.1.2) as their shapes are greatly similar; — transitional components in 4.3.4.8 are inspired by those of the transitional surfaces (see 4.2.2.2); and — lower surfaces are created in order to describe the horizontal surface extending between the inner edges of the other components. The inner edge of all the surfaces are at the elevation of the threshold. The way slopes are measured is a Standard since it is necessary that the slope is consistently measured at all aerodromes in order to prevent misconstructions of the surfaces and to ensure proper assessment of the obstacles.

4.3.4.13 **Recommendation.—** *The slopes of the different components of the surface for precision approach runways should not be greater than, and their other dimensions not less than, those specified in Table 4-14.*

Table 4-14. Dimensions of surface for precision approaches

Aeroplane design group			I to V
Approach component		Distance from threshold	60 m
		Length of inner edge	300 m
	1st section	Length	3 000 m
		Divergence (each side)	15 %
		Slope	2 %
	2nd section	Length	9 600 m
		Divergence (each side)	15 %
		Slope	2.5 %
Missed approach component		Distance after threshold	900 m
		Length of inner edge	300 m
	1st section	Length	1 800 m
		Divergence (each side)	17.48 %
		Slope	2.5 %
	2nd section	Length	10 200 m
		Divergence (each side)	25 %
		Slope	2.5 %
Transitional component		Slope	14.3 %

Origin: OLSTF/24 ADOP/4	*Rationale* The dimensions in Table 4-12 are directly derived from those of the basic ILS surfaces (see PANS-OPS, Volume II, Section 1, Chapter 1, Figure II-1-1-9).

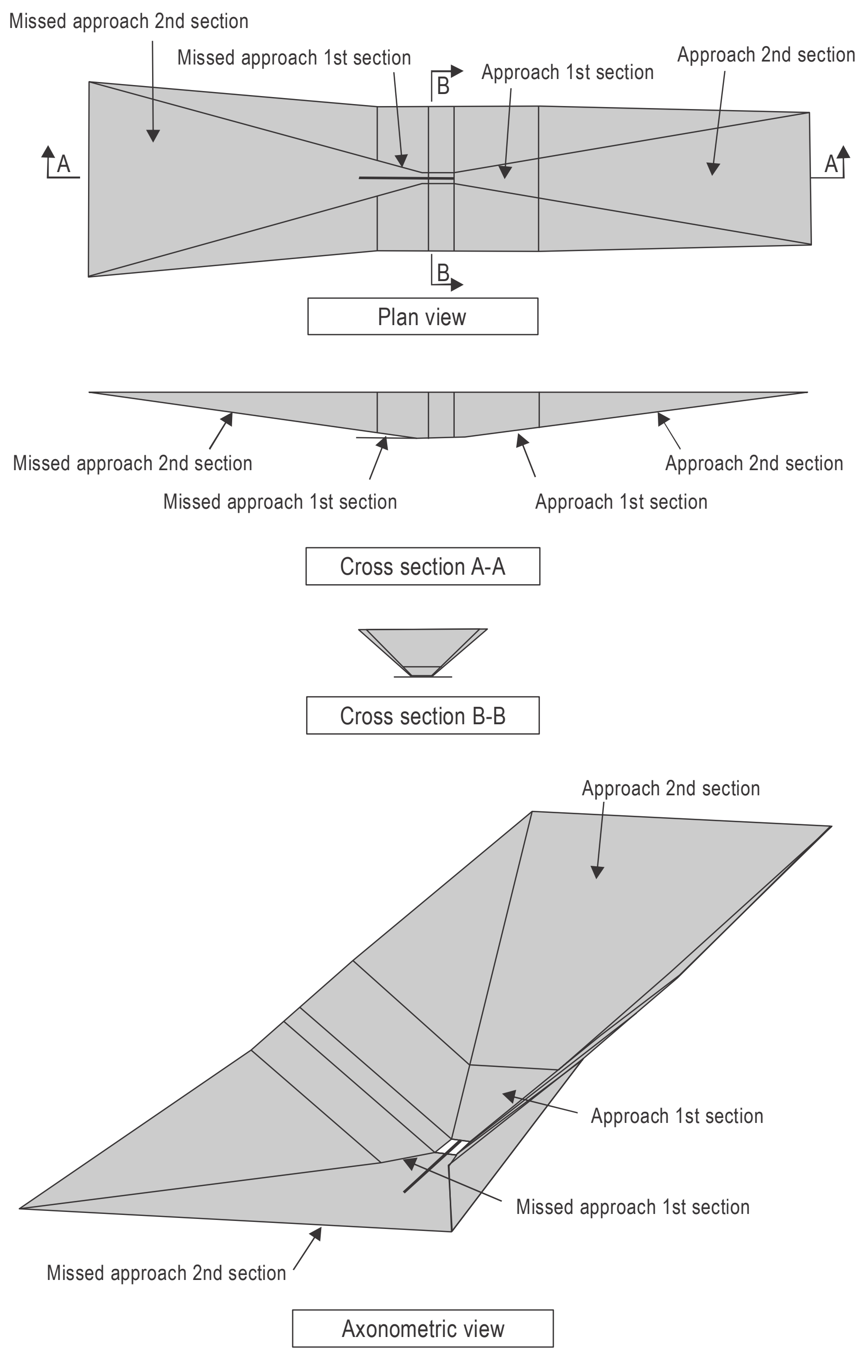

Figure 4-7. Surface for precision approaches

4.3.5 Instrument departure surface

Note.— The purpose of the instrument departure surface is to establish the volume of airspace where obstacles may have an impact on aircraft following an omnidirectional instrument departure procedure. The design of the instrument departure surface is consistent with the dimensions provided in PANS-OPS (Doc 8168, Volume II, Part I, Section 3, Chapter 4).

Origin: OLSTF/24 ADOP/4	*Rationale* The take-off climb surface establishes the airspace that is necessary for the identification of obstacles that may affect the obstacle clearance requirements as per Annex 6 provisions. However, these clearances are not sufficient to permit the promulgation of instrument procedures and obstacles below or beyond the take-off climb surface could impact the accessibility of instrument departures. For this reason, an OES is necessary to ensure the accessibility of the runway to aircraft intended to carryout instrument departures. The airspace of the current take-off climb surface and that proposed in 4.2.6 does not correlate with the obstacle clearance criteria related to instrument departure procedures. Hence, obstacles that are not identified by establishing take-off climb surface, may impact instrument departure procedures and must be assessed. In addition, the take-off climb surface will not guarantee the accessibility of these instrument departure operations. For this reason, on runways intended for instrument departures, a dedicated surface is necessary. This surface will establish the airspace where obstacles affect instrument departure procedures and need to be consistent with the obstacle clearance requirements for instrument departures specified in PANS-OPS, as they fulfil this objective. For the surface to be relevant for all departures, the instrument departure surface rely on the criteria for omnidirectional departures specified in (PANS-OPS, Volume II, Part 1, Section 3, Chapter 4).

4.3.5.1 *Description.— Instrument departure surface.* An inclined surface, along the runway centre line and its extension after the end of the take-off distance available.

4.3.5.2 *Characteristics*.— The limits of the instrument departure surface should comprise:

a) an inner edge of specified length, horizontal and perpendicular to the centre line of the runway and located at the end of the take-off distance available;

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 to a specified distance and diverging uniformly thereafter at another specified rate for the remainder of the length of the instrument departure surface; and

c) an outer edge parallel to the inner edge.

Origin: OLSTF/24 ADOP/4	*Rationale* The description and characteristics are derived from those of the current take-off climb surface. However, the inner edge is located at the end of the TODA (or departure end of the runway (DER)), consistently with the specifications of the obstacle identification surface (OIS) given in PANS-OPS (Doc 8168, Volume II, Part I, Section 3, Chapter 4, 4.3.1): the "… OIS extends from 5 m (16 ft) above the elevation of the DER to the end of the turn initiation area".

4.3.5.3 The elevation of the inner edge shall be 5 m above the elevation of the runway centre line and its extension at the end of the take-off distance available.

4.3.5.4 The slope of the instrument departure surface shall be measured in the vertical plane containing the centre line of the runway and its extension.

Origin: OLSTF/24 ADOP/4	*Rationale* The elevation of the inner edge is made to be consistent with that of the inner edge of the OIS specified in PANS-OPS (Doc 8168, Volume II, Part I, Section 3, Chapter 4, 4.3.1). The instrument departure surface corresponds with the OIS described in PANS-OPS, which is symmetrical about the vertical plane containing the centre line of the runway and its extension (Doc 8168, Volume II, Part I, Section 3, Chapter 4, Figure I-3-4-1). Hence, the slope shall be measured in this vertical plane. This provision is included to ensure consistency in measuring the slope so that relevant obstacles can be identified and evaluated.

4.3.5.5 **Recommendation.—** *The slope of the instrument departure surface should not be greater than, and its other dimensions not less than, those specified in Table 4-15.*

Table 4-15. Dimensions of instrument departure surface

	Aeroplane design group	**I to V**
	Length of inner edge	300 m
	Slope	2.5 %
First section	**Length**	3 500 m
	Divergence	26.8 %
Second section	**Length**	8 300 m
	Divergence	57.8 %

Origin: OLSTF/24 ADOP/4	*Rationale* <u>Length of inner edge, slope, length of the first section and divergences in the first and second sections</u> The dimensions established in Table 4-15 are directly transposed from the specifications in PANS-OPS, Volume II, Part I, Section 3, Chapter 4, 4.3.1 and Figure I-3-4-1. <u>Length of the section</u> The length of the second section is determined to ensure that the surface reaches a height of 300 m, consistently with the height of the current take-off climb surface.

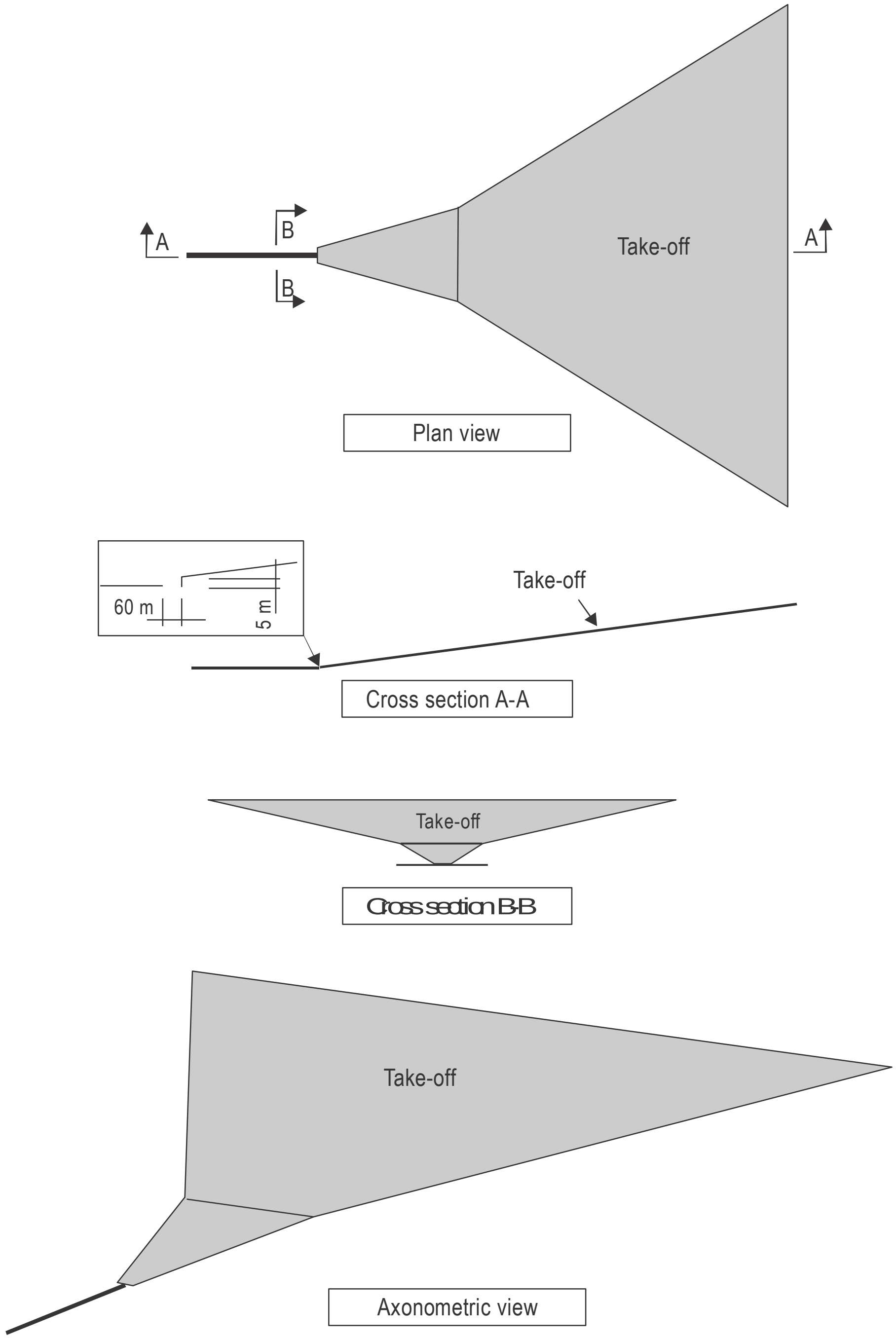

Figure 4-8. Instrument departure surface

4.3.6 Specific obstacle evaluation surfaces

4.3.6.1 **Recommendation.—** *Specific obstacle evaluation surfaces should be established where the obstacle evaluation surfaces described in 4.3.2 to 4.3.5 do not establish the volume of airspace necessary for the identification and evaluation of obstacles that may have an impact on aircraft operations.*

Note.— Specifications concerning the design of a specific obstacle evaluation surface are contained in PANS-Aerodromes (Doc 9981), Part II, Chapter 10.

Origin: OLSTF/24 ADOP/4	*Rationale* The surfaces proposed in 4.3.2 to 4.3.5 are designed to establish the airspace necessary to identify obstacles that may have an impact on typical operations. However, other operations may not be addressed by these surfaces or their variations. In this case, obstacles having an impact on the considered operations may not be identified by the previous surfaces, evaluated and limited, and the accessibility of these operations may not be ensured. Consequently, specific obstacle evaluation surfaces are necessary to establish this airspace and States should have them designed and implemented. These specific obstacle evaluation surfaces can be of any shape and dimensions, other than those specified in Annex 14, Volume I, however, it should be consistent with the obstacle clearance criteria of the intended aircraft operations.

4.4 Obstacle limitation requirements

Inner approach surface, inner transitional surfaces and balked landing surface

4.4.1 Fixed objects shall not be permitted above the inner approach surface, inner transitional surfaces and balked landing surface and that complex surface extending between the lower edges of the inner transitional surfaces. Visual aids required for air navigation purposes or those objects required for aircraft safety purposes, and which must project into the airspace above the inner approach surface, inner transitional surfaces and balked landing surface or that complex surface extending between the lower edges of the inner transitional surfaces are permitted.

Note.— Specifications concerning objects required for aircraft safety purposes are provided in the Airport Services Manual *(Doc 9137), Part 6 –* Control of Obstacles. *Such objects may for example consist of arresting systems, arresting cables, arresting beds, FOD detection systems, wildlife hazard equipment.*

4.4.2 Visual aids required for air navigation purposes or those fixed objects required for aircraft safety purposes and which project into the airspace above the inner approach surface, inner transitional surfaces and balked landing surface or that complex surface extending between the lower edges of the inner transitional surfaces shall be frangible and mounted as low as possible.

4.4.3 Mobile objects shall not be permitted above the inner approach surface, inner transitional surfaces, balked landing surface and that complex surface extending between the lower edges of the inner transitional surfaces during the use of the runway for landing.

Origin: OLSTF/24 ADOP/4	*Rationale* Regarding 4.4.2, the obstacle limitation requirements start with the surfaces that are closer to the runway where, obstacle limitations need to be stricter. The intent of the inner approach, inner transitional surfaces and balked landing surfaces is to limit mobile objects and fixed objects in order to ensure the safety of late go-arounds and balked landings and harmonize the limitation of mobile objects. Consistently with existing Annex 14, Volume I, Chapter 4, 4.2.18, no fixed object should ideally penetrate these surfaces considering their close proximity to the runway. However, some objects must stand on the strip (“equipment or installation required for air navigation or for aircraft safety purposes”, see Chapter 9, 9.9.4) and may infringe these surfaces. In order to be as specific as possible regarding the objects that may infringe the considered surface: a) instead of dealing with “equipment and installation” which are not specified, the term fixed objects is retained; and b) considering that it “is intended that the inner transitional surface be the controlling obstacle limitation surface for navigation aids […]” (see the current note on the intent of the inner transitional surface), the resulting acceptable objects are specified under “visual aids required for air navigation purposes or those objects required for aircraft safety purposes”. Regarding 4.4.2, when “visual aids required for air navigation purposes or those objects required for aircraft safety purposes” infringe the inner approach and inner transitional surfaces, it is considered that they shall meet frangibility requirements and be mounted as low as possible (consistently with existing 4.2.18 and 9.9.5.b)). Finally, 4.4.3 requires that mobile objects do not infringe the inner approach surface, inner transitional surfaces and balked landing surfaces, consistently with existing 4.2.18.

Approach surface, take off climb surface and transitional surfaces

4.4.4 New objects or extensions of existing objects shall not be permitted above the approach surface, take off climb surface and transitional surfaces and the complex surface extending between the lower edges of the transitional surfaces. Equipment and installations required for air navigation or for aircraft safety purposes, and which must project into the airspace above the approach surface, take off climb surface and transitional surfaces or that complex surface extending between the lower edges of the transitional surfaces are permitted.

4.4.5 Equipment and installations required for air navigation or for aircraft safety purposes and which must project into the airspace above the approach surface, take off climb surface and transitional surfaces or that complex surface extending between the lower edges of the transitional surfaces shall be frangible and mounted as low as possible.

Origin: OLSTF/24 ADOP/4	*Rationale* The obstacle requirements continue with those associated with the approach surface, take off climb surface and transitional surface. In the airspace above these surfaces, it is considered that approach, take-off and go-around operations happen and shall not encounter fixed objects. For this reason, extensions of existing objects and new fixed objects are prohibited. This requirement is consistent with the existing 4.2.3, 4.2.10 and 4.2.19. However, "equipment or installations required for air navigation or for aircraft safety purposes", as mentioned in Chapter 9, 9.9 of Annex 14, Volume I needs to be considered, hence the new provisions 4.4.4 and 4.4.5 have been included.

4.4.6 **Recommendation.**— *Existing obstacles above the approach surface, take off climb surface and transitional surfaces or that complex surface extending between the lower edges of the transitional surfaces should as far as practicable be removed.*

4.4.7 States shall ensure that existing terrain and/or obstacles that cannot be removed and penetrate the approach surface, take off climb surface and transitional surfaces or that complex surface extending between the lower edges of the transitional surfaces are only permitted when, after aeronautical study, it is determined that the obstacles do not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

Note.— Detailed specifications concerning aeronautical study are provided in PANS-Aerodromes (Doc 9981), Part II, Chapter 10.

Origin: OLSTF/24 ADOP/4	*Rationale* The objective of obstacle free surfaces, is to provide a volume of airspace free from obstacles. However, under certain existing obstacle environment, objects and terrain may penetrate the proposed OFS. Removal of such infringements is necessary to ensure the absence of obstacles above the OFS. However, terrain and existing obstacles may not be practically or legally removable, hence 4.4.6 can only be a recommendation. Where removing existing obstacles and terrain penetrating the OFS is not feasible, an aeronautical study is necessary to evaluate the impact of the penetrations on operations and to determine the possible mitigations. Therefore this is proposed as a Standard in 4.4.7. This is necessary to ensure that the impact of existing obstacles and terrain on the operations is fully considered and accounted.

Obstacle evaluation surfaces

4.4.8 States shall ensure that obstacles penetrating the obstacle evaluation surfaces are only permitted when, after aeronautical study, it is determined that the obstacles do not adversely affect the safety or significantly affect the regularity of the existing and intended operations of aeroplanes.

Note.— Detailed specifications concerning aeronautical study is given in PANS-Aerodromes (Doc 9981), Part II, Chapter 10.

Origin: OLSTF/24 ADOP/4	*Rationale* The obstacle evaluation surfaces are intended to trigger the evaluation of obstacles that penetrate them. Hence, an aeronautical study shall be conducted where an obstacle is infringing an obstacle evaluation surface, and this study shall evaluate the impact of the obstacle on the existing and intended operations of aeroplanes at the aerodrome. The study should also evaluate possible mitigations. The outcome of the study shall serve as a basis to determine the acceptability of the considered obstacle. Obstacles shall not affect the safety and regularity of operations at the aerodrome.

4.5 Obstacle limitation surfaces requirements

Note 1.— The requirements for obstacle free 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.

Note 2.— The requirements for obstacle evaluation surfaces are specified on the basis of the intended use and/or intended operations on the runway. When different obstacle evaluation surfaces overlap each other, each individual surface must be considered as they have specific functions.

4.5.1 Obstacle free surfaces:

4.5.1.1 The following obstacle free surfaces shall be established for a non-instrument or non-precision approach runway:

a) approach surface;

b) transitional surfaces;

c) inner approach surface; and

d) inner transitional surfaces.

4.5.1.2 The following obstacle free surfaces shall be established for a precision approach runway:

a) Approach surface;

b) transitional surfaces;

c) inner approach surface;

d) inner transitional surfaces; and

e) balked landing surface.

4.5.1.3 Where the runway is meant for take-off , the take-off climb surface shall be established.

4.5.2 Obstacle evaluation surfaces:

4.5.2.1 **Recommendation**.— *The following obstacle evaluation surfaces should be established:*

a) *in case of circling approach — the horizontal surface;*

b) *in case of straight-in instrument approaches other than precision approaches, where the horizontal surface is not established — the surface for straight-in instrument approaches;*

c) *in case of precision approach procedure — the surface for precision approaches; and*

d) *in case of instrument departure procedure — the instrument departure surface.*

Origin: OLSTF/24 ADOP/4	*Rationale* This is similar to the existing provisions in Annex 14, Volume I, Chapter 4. However the requirements of establishing specific OFS for non- instrument, non-precision and precision runways have been clearly mentioned. Similarly, the requirement of establishing OES based on the approach and departure procedures at an aerodrome has been included as a recommendation.

4.6 Objects outside the obstacle free surfaces and obstacle evaluation surfaces

4.6.1 **Recommendation**.— *In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 100 m or more above ground elevation should be regarded as obstacles, unless an aeronautical study indicates that they do not constitute a hazard to the operations of intended aeroplane.*

Origin: OLSTF/24 ADOP/4	*Rationale* Procedures conducted under instrument flight rules are protected by surfaces specified according to PANS-OPS criteria. The extent of these surfaces is large. For instance, minimum sector altitudes provide protection within 30 NM (including the protection buffer) of the significant point associated with the approach procedure for the aerodrome; likewise, protection areas for standard instrument departures (SIDs) and standard instrument arrivals (STARs) are also significantly large. Moreover, there are several altitude limitations established to ensure the safety of en route phase of flight far away from the aerodromes. For example, area minimum altitude, obstacle clearance for radar vectoring or other. Due to this, objects outside the obstacle free surfaces and obstacle evaluation surfaces may have an impact on operations. As a way of managing the safety risks arising from aerodromes, States should establish *obstacle control height* at any place in its territory. Furthermore, 100 m is also consistent with the requirements on publication of obstacles in Area 1 stated in Annex 15 — *Aeronautical Information Services* and the requirements of Annex 2 — *Rules of the Air* .

End of new text.

INITIAL PROPOSAL 3
Review of aerodrome reference code (ARC) design method and governing parameter

CHAPTER 3. PHYSICAL CHARACTERISTICS

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3.4 Runway strips

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Width of runway strips

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Origin: ADWG/20, ARCTF/10 and Veer-off Data base Special Meetings, ADOP/4	*Rationale* Proposed reduction in half strip width for Code 3 non-instrument (NINST) runway from 75 m to 55 m (para 3.4.5) with consequential changes to grading (3.4.9), strength requirements (3.4.18) and Tables 3-1, 3-2 and 4-1. For determining safety areas and minimum requirements related to runways, the Aerodrome Reference Code Task Force (ARCTF) established a considerable database germane to lateral runway veer-offs containing a total of 5 684 cases over a 24-year period from 1995 to 2018. Looking at the real incident cases on NINST runways (4 663), the resulting capture rates with the proposed value of 55 m for non-instrument runways where the code number is 3 (82.5 per cent) is more than the current overall average capture rate (82.0 per cent). A detailed analysis of the range proposed to be lowered (i.e. NINST runways where the code number is 3 with half strip widths between 55 m to 75 m and aeroplane reference field length (ARFL) 2, 3 or 4) demonstrates that in all six cases, there had been no fatalities nor injuries. However, there were some cases where Codes 3 or 4 aircraft operating on NINST runway where the code number is 2 that could had been captured within a half strip width of the proposed 55 m. Per Job Card ADOP.005.004, the ARCTF was tasked to review and develop provisions for NINST runways. If the review indicated that some Standards and Recommended Practices (SARPs) were too conservative, there was an efficiency and capacity issue that should be addressed. The proposed amendment more accurately reflects the required strip width in relation to the ARFL and will remove the geometrical discrepancy between the widths of runway strips in case of NINST runways. The proposal allows some Code 2 aerodromes currently unable to provide the requirement of 75 m runway half strip width for Code 3, to attain the overall higher safety criteria (wider strip width, dimensions of the runway end safety area (RESA), visual aids requirement) for a Code 3 NINST runway environment. Effectively, this would mean that for aerodromes currently providing, say, a 55 m half strip width, would be placed in the Code 2 classification (as per current para 3.4.5 requirements, Annex 14, Volume I). Having a new in-between step between 40 m and 75 m would therefore

	allow some Code 2 aerodromes with the possibility to provide a greater strip than 40 m, but cannot reach the current required strip width of 75 m, to be classified as Code 3 aerodromes by applying the proposed value of 55 m and therefore attain a higher safety level as described. As in the case of NINST runways, there is no differentiation between the graded and non-graded portion of the runway strip.

3.4.5 **Recommendation.—** *A strip including a non-instrument runway should extend on each side of the centre line of the runway and its extended centre line throughout the length of the strip, to a distance of at least:*

— *75 m where the code number is ~~3 or~~ 4;*

— *55 m where the code number is 3;*

— *40 m where the code number is 2; and*

— *30 m where the code number is 1.*

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Grading of runway strips

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3.4.9 **Recommendation.—** *That portion of a strip of a non-instrument runway within a distance of at least:*

— *75 m where the code number is ~~3 or~~ 4;*

— *55 m where the code number is 3;*

— *40 m where the code number is 2; and*

— *30 m where the code number is 1;*

from the centre line of the runway and its extended centre line should provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

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Strength of runway strips

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3.4.18 **Recommendation.—** *That portion of a strip containing a non-instrument runway within a distance of at least:*

— *75 m where the code number is ~~3 or~~ 4;*

— *55 m where the code number is 3;*

— *40 m where the code number is 2; and*

— *30 m where the code number is 1;*

from the centre line of the runway and its extended centre line should be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

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Table 3-1. Taxiway minimum separation distances

Code letter	Distance between taxiway centre line and runway centre line (metres)								Taxiway centre line to taxiway centre line (metres)	Taxiway, other than aircraft stand taxilane, centre line to object (metres)	Aircraft stand taxilane centre line to aircraft stand taxilane centre line (metres)	Aircraft stand taxilane centre line to object (meters)
	Instrument runways Code number				Non-instrument runways Code number							
	1	2	3	4	1	2	3	4				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
A	77.5	77.5	–	–	37.5	47.5	–	–	23	15.5	19.5	12
B	82	82	152	–	42	52	~~87~~ 67	–	32	20	28.5	16.5
C	88	88	158	158	48	58	~~93~~ 73	93	44	26	40.5	22.5
D	–	–	166	166	–	–	~~101~~ 81	101	63	37	59.5	33.5
E	–	–	172.5	172.5	–	–	~~107.5~~ 87.5	107.5	76	43.5	72.5	40
F	–	–	180	180	–	–	~~115~~ 95	115	91	51	87.5	47.5

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Origin: ADWG/20, ARC-TF/10 and Veer-off Data base Special Meetings; ADOP/4	*Rationale* The values for taxiway minimum separation distances in Table 3-1 have been calculated in terms of the runway strip width and half of the wingspan of the corresponding aircraft on a parallel taxiway. The values in Column 8 have been reduced in Table 3-2, using a half strip width of 55 m instead of 75 m.

Table 3-2. Minimum distance from the runway centre line to a holding bay, runway-holding position or road-holding position

Type of runway	Code number 1	2	3	4
Non-instrument	30 m	40 m	~~75m~~ 55m	75m
Non-precision approach	40 m	40 m	75m	75m
Precision approach category I	60 m[b]	60 m[b]	90 m[a,b]	90 m[a,b]
Precision approach categories II and III	—	—	90 m[a,b]	90 m[a,b]
Take-off runway	30 m	40 m	~~75m~~ 55m	75m

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Origin: ADWG/20, ARC-TF/10 and Veer-off Data base Special Meetings; ADOP/4	*Rationale* The values for minimum distance from the runway centre line to a holding bay, runway-holding position or road-holding position in Table 3-2 are in case of a non-instrument runway and a take-off runway identical to the corresponding runway strip width.

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3.11 Taxiway strips

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Grading of taxiway strips

3.11.4 **Recommendation.—** *The centre portion of a taxiway strip should provide a graded area to a distance from the centre line of the taxiway of not less than that given by the following tabulation:*

— *10.25 m where the OMGWS is up to but not including 4.5 m;*

— *11 m where the OMGWS is 4.5 m up to but not including 6 m;*

— *12.50 m where the OMGWS is 6 m up to but not including 9 m;*

— *~~18.50~~ 17 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is D;*

— *19 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is E;*

— *22 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is F.*

Note.— Guidance on width of the graded portion of a taxiway is given in the Aerodrome Design Manual *(Doc 9157), Part 2.*

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Origin: ADWG/18; ADOP/WG/5; ADOP/4	*Rationale* Proposed correction to the width of the graded portion of code letter D taxiway strip: Per the eighth edition of Annex 14, Volume I, Amendment 14, the values of the graded portion of taxiway strips (para 3.11.4, half -widths) is equal to half of the "taxiway plus shoulder" widths (para 3.10.1, full widths): ½ (taxiway width + shoulder width) Using this formula, the "taxiway plus shoulder" width for taxiways with OMGWS 9 m up to but not including 15 m where the code letter is D equals 34 m, resulting in a graded portion of taxiway strip width of half of 34 m, which is 17 m and not 18.5 m as indicated in Amendment 14.

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CHAPTER 4. OBSTACLE RESTRICTION AND REMOVAL

Applicable until 22 November 2028.

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.

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Table 4-1. Dimensions and slopes of obstacle limitation surfaces — Approach runways

APPROACH RUNWAYS

	RUNWAY CLASSIFICATION									
	Non-instrument Code number				Non-precision approach Code number			Precision approach category I Code number		Precision approach category II or III Code number
Surface and dimensions[a]	1	2	3	4	1,2	3	4	1,2	3,4	3,4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	—	—	—	—	—	—	—	90 m	120 m[e]	120 m[e]
Distance from threshold	—	—	—	—	—	—	—	60 m	60 m	60 m
Length	—	—	—	—	—	—	—	900 m	900 m	900 m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	~~150~~ 110m	150 m	140 m	280 m	280 m	140 m	280 m	280 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	—	—	—	—	—	3 600 m[b]	3 600 m[b]	12 000 m	3 600 m[b]	3 600 m[b]
Slope	—	—	—	—	—	2.5%	2.5%	3%	2.5%	2.5%

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

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Origin:	*Rationale*
ADWG/20, ADWG/19, OLS-TF, ADOP/4	Consequential to the proposed half strip width for Code 3 NINST runway in Annex 14, Volume I, 3.4.5, the current value in Table 4-1 for the length of the inner edge (Column 4) is revised to be in line with the proposed change. Table 4-1 will cease to exist when the new Chapter 4 provisions in Initial Proposal 2 become applicable in 2028.

INITIAL PROPOSAL 4
International provisions addressing ground handling at aerodromes

CHAPTER 3. PHYSICAL CHARACTERISTICS

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3.13 Aprons

General

3.13.1 **Recommendation.—** *Aprons should be provided where necessary to permit the on- and off-loading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the aerodrome traffic.*

3.13.2 **Recommendation.—***The design of aprons should take into consideration criteria for safe ground handling, including:*

a) *sufficient space between aircraft stands to enable personnel and equipment to move safely and efficiently;*

b) *adequate apron markings, apron signs and apron floodlighting;*

c) adequate staging and storage areas for ground support equipment (GSE);

d) positioning of fixed ground services;

e) storage areas for unit load devices (ULD);

f) adequate access and egress routes for fuel, GSE and emergency vehicles;

g) clearly delineated and visible access and egress routes for passengers;

h) new technologies (electric charging points, autonomous vehicles, etc.);

i) avoidance of rear of aircraft stand service roads wherever practicable; and

j) appropriate protection for persons, equipment and infrastructure from jet blast and propeller wash.

Note.— Further guidance on apron design and markings is given in the Aerodrome Design Manual *(Doc 9157), Part 4 —* Visual Aids*, and the* Airport Planning Manual *(Doc 9184), Part 1—* Master Planning.

Size of aprons

3.13.~~2~~3 **Recommendation.—** *The total apron area should be adequate to permit safe and expeditious handling of the aerodrome traffic at its maximum anticipated density.*

Strength of aprons

3.13.~~3~~4 **Recommendation.—** *Each part of an apron should be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that some portions of the apron will be subjected to a higher density of traffic and, as a result of slow moving or stationary aircraft, to higher stresses than a runway.*

Slopes on aprons

3.13.~~4~~5 **Recommendation**.— *Slopes on an apron, including those on an aircraft stand taxilane, should be sufficient to prevent accumulation of water on the surface of the apron but should be kept as level as drainage requirements permit.*

3.13.~~5~~6 **Recommendation**.— *On an aircraft stand the maximum slope should not exceed 1 per cent.*

Origin	*Rationale*
GHTF/14 ADOP/4	The changes proposed to Section 3.13 aim to ensure design criteria for aprons to include safety related aspects affecting ground handling activities on aerodromes. These provisions are applicable while designing new aprons or while altering the design of existing aprons.

Clearance distances on aircraft stands

3.13.~~6~~7 **Recommendation.—** *An aircraft stand should provide the following minimum clearances between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand and other objects:*

Code letter	Clearance
A	*3 m*
B	*3 m*
C	*4.5 m*
D	*7.5 m*
E	*7.5 m*
F	*7.5 m*

When special circumstances so warrant, these clearances may be reduced at a nose-in aircraft stand, where the code letter is D, E or F:

a) between the terminal, including any fixed passenger boarding bridge, and the nose of an aircraft; and

b) over any portion of the stand provided with azimuth guidance by a visual docking guidance system.

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Origin: GHTF/14 ADOP/4	*Rationale* In Annex 14, Volume I, the terms passenger bridge, passenger loading bridge, loading bridge and aerobridge are used to represent a passenger boarding bridge. They were unified to one terminology i.e. passenger boarding bridge. When defining ground handling provisions, boarding should be used for passengers, avoiding loading, which is reminiscent of cargo loading.

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CHAPTER 5. VISUAL AIDS FOR NAVIGATION

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5.3 Lights

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5.3.25 Visual docking guidance system

Application

5.3.25.1 A visual docking guidance system shall be provided when it is intended to indicate, by a visual aid, the precise positioning of an aircraft on an aircraft stand and other alternative means, such as marshallers, are not practicable.

Note.— The factors to be considered in evaluating the need for a visual docking guidance system are in particular: the number and type(s) of aircraft using the aircraft stand, weather conditions, space available on the apron and the precision required for manoeuvring into the parking position due to aircraft *servicing installation, passenger* ~~*loading*~~ *boarding bridges, etc. See the* Aerodrome Design Manual *(Doc 9157), Part 4 —* Visual Aids *for guidance on the selection of suitable systems.*

Characteristics

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5.3.25.6 The accuracy of the system shall be adequate for the type of ~~loading~~ passenger boarding bridge and fixed aircraft servicing installations with which it is to be used.

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Origin*:* GHTF/14 ADOP/4	*Rationale*: In Annex 14, Volume I, the terms passenger bridge, passenger loading bridge, loading bridge and aerobridge are used to represent passenger boarding bridge. They were unified to one terminology i.e. passenger boarding bridge. When defining ground handling provisions, boarding should be used for passengers, avoiding loading, which is reminiscent of cargo loading.

CHAPTER 6. VISUAL AIDS FOR DENOTING OBSTACLES

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6.2 Marking and/or lighting of objects

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6.2.2 Mobile objects

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Lighting

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6.2.2.8 Low-intensity obstacle lights on objects with limited mobility such as passenger boarding ~~aero~~bridges shall be fixed-red, and as a minimum be in accordance with the specifications for low-intensity obstacle lights, Type A, in Table 6-1. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

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Origin: GHTF/14 ADOP/4	*Rationale* In Annex 14, Volume I, the terms passenger bridge, passenger loading bridge, loading bridge and aerobridge are used to represent passenger boarding bridge. They were unified to one terminology i.e. passenger boarding bridge. When defining ground handling provisions, boarding should be used for passengers, avoiding loading, which is reminiscent of cargo loading.

CHAPTER 9. AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

9.1 Aerodrome emergency planning

General

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9.1.3 The plan shall coordinate the response or participation of all existing agencies which, in the opinion of the appropriate authority, could be of assistance in responding to an emergency.

Note 1.— Examples of agencies are:

— *on the aerodrome: air traffic control units, rescue and firefighting services, aerodrome administration, medical and ambulance services, aircraft operators, ground handling service providers, security services, and police;*

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9.5 Apron management service

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9.5.7 **Recommendation.—***Aircraft should be allocated to an aircraft stand or apron area appropriate to the aircraft characteristics.*

9.5.8 **Recommendation**.**—** *A risk assessment should be carried out if there is a need to allocate aircraft parking to areas other than aircraft stands or apron areas.*

Note .—The need to allocate aircraft to other areas could arise from situations such as mass diversions, special events, contingency requirements, work in progress, etc..

9.5.9 Aircraft shall be guided while arriving on or departing from the aircraft stand.

Note.— Means for guidance can be a visual docking guidance systems, personnel or markings.

9.5.~~7~~10 An aircraft stand shall be visually monitored in-person or remotely to ensure that the recommended clearance distances are ~~provided to an aircraft using the stand~~ maintained.

Note.— Stand dependencies may occur when multiple centre lines are used on the same stand, creating possible variations in fixed or mobile obstacle separations with adjacent stands.

9.5.11 Emergency stop procedures shall be in place to stop aircraft when the safety of operations on the aircraft stand is compromised.

Note.— Procedures on the training of operational personnel, and on apron safety and operations, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapters 1 and 7.

9.5.12 **Recommendation.—** *When allocating an aircraft to an aircraft stand, the following parameters should be considered:*

a) parking aids;

b) facilities serving the aircraft stand;

c) proximity of infrastructure;

d) other parked aircraft in the neighbouring aircraft stands;

e) aircraft stand dependencies; and

f) jet blast and propeller wash related protection.

9.5.13 Personnel, other than those required to assist the initial arrival and departure of the aircraft, shall not be allowed to approach the aircraft when anti-collision lights are turned on and engines are running.

9.5.14 Parked aircraft shall be appropriately secured to prevent any unintended movement.

Origin: GHTF/17, ADOP/4	*Rationale:* The additional provisions 9.5.7, 9.5.8, 9.5.9, 9.5.11 and 9.5.12 were added to ensure that apron management services consider the requirements related to ground handling safety when manoeuvring the aircraft on to and off the stand, in order to safeguard the aircraft. 9.5.13 would ensure the safety of personnel operating around the aircraft. 9.5.14 would ensure the protection of aircraft, infrastructure, those on board and working around it from the unintended movement of an aircraft. The unintended movement of aircraft is avoided through procedures such as appropriate chocking, mooring, etc.

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9.6 Ground servicing of aircraft

(Applicable until 25 November 2026)

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9.6 Ground handling

(Applicable as of 26 November 2026)

Note.— Ground handling can be provided by an aircraft operator, an aerodrome operator or an independent organization. When provided by an aircraft operator or an aerodrome operator, this organization is also considered, as a ground handling service provider (GHSP).

9.6.1 States shall regularly assess the impact of ground handling operations on aviation safety.

Note.— Guidance on the assessment of the impact of ground handling operations on aviation safety is provided in the Manual on Ground Handling *(Doc 10121), Chapter 2.*

9.6.2. **Recommendation.—** *States should establish criteria for the safety oversight of ground handling as part of their State Safety Programme (SSP).*

Note 1.— Guidance on the establishment of criteria for the safety oversight of ground handling, and approaches for safety oversight are contained in the Manual on Ground Handling *(Doc 10121)*

Note 2.— Provisions on periodically reviewing the need to extend SMS to additional aviation sectors are contained in Annex 19 – Safety Management. *Examples of additional aviation sectors can include GHSP.*

9.6.3 Fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire and personnel trained in its use shall be readily available during ground servicing of an aircraft, and there shall be a means of quickly summoning the rescue and firefighting service in the event of a fire or major fuel spill.

9.6.4 When aircraft refuelling operations take place while passengers are embarking, on board or disembarking, ground equipment shall be positioned so as to allow:

a) the use of a sufficient number of exits for expeditious evacuation; and

b) a ready escape route from each of the exits to be used in an emergency.

Origin: GHTF/17, ADOP/4	*Rationale* The new 9.6.1 and 9.6.2 and accompanying notes will require States to conduct an impact assessment and provide the flexibility to decide on the oversight requirements for ground handling. This will facilitate in ensuring a balanced approach in implementing provisions related to ground handling in a phased manner. New 9.6.3 and 9.6.4 are renumbered from the original 9.6.1 and 9.6.2, respectively.

INITIAL PROPOSAL 5
Visual aids for day/night and all weather operations

CHAPTER 5. VISUAL AIDS FOR NAVIGATION

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5.2 Markings

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5.2.4 Threshold marking

Application

5.2.4.1 A threshold marking shall be provided at the threshold of a paved instrument runway, and of a paved non-instrument runway where the code number is 3 or 4 ~~and the runway is intended for use by international commercial air transport~~.

5.2.4.2 **Recommendation**.— *A threshold marking should be provided at the threshold of a paved non-instrument runway where the code number is ~~3 or 4 and the runway is intended for use by other than international commercial air transport~~. 1 or 2 and additional conspicuity of the beginning of the runway available for landing is necessary.*

. . .

Origin: VAWG/17, ADOP-WG/4, ADOP/4	*Rationale* Currently, in Annex 14, Volume I, Chapter 5, 5.2.4, there is no requirement for the application of threshold markings in case of paved NINST runways where the code number is 1 or 2. This is not in line with provisions for runway centre line marking (5.2.3) and runway designation marking (5.2.2), where those markings are applicable for all kinds of paved runways. A coherent applicability for the basic patterns of runway markings (runway threshold marking, runway designation marking and runway centre line marking) would facilitate the use and understanding of the Annex 14, Volume I provisions. Most of the concerned aerodromes already have applied runway threshold markings on all kinds of runways. The application of runway threshold marking is not expensive nor time-consuming: improvement in aerodrome safety can be easily achieved with negligible cost of implementating the proposals.

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5.3 Lights

5.3.1 General

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Light intensity and control

Note.— In dusk or poor visibility conditions by day, lighting can be more effective than marking. For lights to be effective in such conditions or in poor visibility by night, they must be of adequate intensity. To obtain the required intensity, it will usually be necessary to make the light directional, in which case the arcs over which the light shows will have to be adequate and so orientated as to meet the operational requirements. The runway lighting system will have to be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end and are maintained over time. (See Attachment A, Section 15, ~~and~~ on intensity. Guidance on maintenance criteria for aeronautical ground lights and on the use of a site standard is contained in the Aerodrome Design Manual *(Doc 9157), Part 4).*

. . .

Origin: ADOP/4	*Rationale* The note under the "light intensity and control" heading should be amended in line with the changes to Annex 14, Volume I, Chapter 10, 10.5.1 and Doc 9157, Part 4, Chapter 19, 19.2.18, Site standard, while also making reference to the relevant part of the manual, when deciding on intensity of the runway lighting system.

5.3.12 Runway centre line lights

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Location

5.3.12.5 Runway centre line lights shall be located along the centre line of the runway, except that the lights may be uniformly offset to the same side of the runway centre line by not more than 60 cm where it is not practicable to locate them along the centre line. The lights shall be located from the threshold to the end at longitudinal spacing of approximately 15 m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in 10.5.7 or 10.5.11, as appropriate, can be demonstrated and the runway is intended for use in runway visual range conditions of~~350~~ 300 m or greater, the longitudinal spacing may be approximately 30 m.

. . .

Origin: VAWG/15, ADOP/4	*Rationale* Runway centre line light spacing requirements should align with the CAT II RVR definition, allowing a light spacing of 30 m for runways intended for use in RVR conditions down to 300 m. Harmonization will not result in any change to the 300 m CAT II RVR value.

5.3.15 Rapid exit taxiway indicator lights

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Application

5.3.15.1 **Recommendation**.— *Rapid exit taxiway indicator lights should be provided on a runway intended for use in runway visual range conditions less than a value of~~350~~ 300 m and/or where the traffic density is heavy.*

Note.— See Attachment A, Section 14.

. . .

Origin: VAWG/15, ADOP/4	*Rationale* Rapid exit taxiway indicator lights application should align with the CAT II RVR definition for runways intended for use in runway visual range conditions of less than 300 m RVR.

	A study performed in a certified simulator provided evidence that flight crew could maintain positive centre line guidance in conditions down to 300 m RVR on taxiways originally designed to 350 m RVR specifications. Taxiway infrastructure harmonization will: a) not result in any change to the 300 m CAT II RVR value; b) remove existing conflict and resultant ambiguity, between runway capability and supporting aerodrome visual aid infrastructure; and c) eliminate missed approaches and their associated risk, as well as diversions in conditions where a landing can be carried out, but the aircraft cannot taxi to the apron as the taxiway lighting system is not compliant with operations below RVR 350 m despite the runway being compliant with CAT II RVR.

5.3.17 Taxiway centre line lights

Origin: ADOP-WG2, VAWG/16, ADOP/4	*Rationale:* A study performed in a certified simulator provides evidence that flight crew can maintain positive centre line guidance in conditions down to 300 m RVR on taxiways originally designed to 350 m RVR specifications. Mathematical comparisons also indicate that a human is not visually able to identify the difference between an RVR of 350 m and 300 m with a taxiway centre line lighting of 30 m across all lighting intensities. Taxiway infrastructure harmonization will: a) not result in any change to the 300 m CAT II RVR value; b) remove existing conflict and resultant ambiguity, between runway capability and supporting aerodrome visual aid infrastructure; and c) eliminate missed approaches and their associated risk, as well as diversions in conditions where a landing can be carried out, but the aircraft cannot taxi to the apron as the taxiway lighting system is not compliant with operations below RVR 350m despite the runway being compliant with CAT II RVR.

Application

5.3.17.1 Taxiway centre line lights shall be provided on an exit taxiway, taxiway, de-icing/anti-icing facility and apron intended for use in runway visual range conditions less than a value of~~350 m~~ 300 m in such a manner as to provide continuous guidance between the runway centre line and aircraft stands, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

5.3.17.2 **Recommendation.—** *Taxiway centre line lights should be provided on a taxiway intended for use at night in runway visual range conditions of ~~350~~ 300 m or greater, and particularly on complex taxiway intersections and exit taxiways, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.*

. . .

5.3.17.4 Taxiway centre line lights shall be provided on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of ~~350~~ 300 m, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

. . .

5.3.17.9 Taxiway centre line lights shall be in accordance with the specifications of:

a) Appendix 2, Figure A2-12, A2-13, or A2-14, for taxiways intended for use in runway visual range conditions of less than a value of ~~350~~ 300 m; and

b) Appendix 2, Figure A2-15 or A2-16, for other taxiways.

5.3.17.10 **Recommendation.—** *Where higher intensities are required, from an operational point of view, taxiway centre line lights on rapid exit taxiways intended for use in runway visual range conditions less than a value of ~~350~~ 300 m should be in accordance with the specifications of Appendix 2, Figure A2 -12. The number of levels of brilliancy settings for these lights should be the same as that for the runway centre line lights.*

Origin: VAWG/16, ADOP/4	*Rationale* Consequential amendment arising from paragraphs 5.3.17.2 and 5.3.17.4.

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Taxiway centre line lights on taxiways

Location

5.3.17.13 **Recommendation.—** *Taxiway centre line lights on a straight section of a taxiway should be spaced at longitudinal intervals of not more than 30 m, except that:*

. . .

c) on a taxiway intended for use in RVR conditions of less than a value of ~~350~~ 300 m, the longitudinal spacing should not exceed 15 m.

. . .

5.3.17.15 **Recommendation**.— *On a taxiway intended for use in RVR conditions of less than a value of ~~350~~ 300 m, the lights on a curve should not exceed a spacing of 15 m, and on a curve of less than 400 m radius the lights should be spaced at intervals of not greater than 7.5 m. This spacing should extend for 60 m before and after the curve.*

Note 1.— Spacings on curves that have been found suitable for a taxiway intended for use in RVR conditions of ~~350~~ 300 m or greater are:

Curve radius	Light spacing
up to 400 m	*7.5 m*
401 m to 899 m	*15 m*
900 m or greater	*30 m.*

. . .

Taxiway centre line lights on runways

Location

5.3.17.20 **Recommendation.—** *Taxiway centre line lights on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of~~350~~ 300 m should be spaced at longitudinal intervals not exceeding 15 m.*

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5.3.19 Runway turn pad lights

Application

5.3.19.1 Runway turn pad lights shall be provided for continuous guidance on a runway turn pad intended for use in runway visual range conditions less than a value of~~350~~ 300 m, to enable an aeroplane to complete a 180-degree turn and align with the runway centre line.

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5.3.21 Intermediate holding position lights

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Application

5.3.21.1 Except where a stop bar has been installed, intermediate holding position lights shall be provided at an intermediate holding position intended for use in runway visual range conditions less than a value of~~350~~ 300 m.

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Origin: ADOP-WG/2, VAWG/16, ADOP/4	*Rationale* A study performed in a certified simulator provided evidence that flight crew could maintain positive centre line guidance in conditions down to 300 m RVR ontaxiways originally designed to 350 m RVR specifications. Mathematical comparisons also indicated that the human eye was not able to identify the difference between an RVR of 350 m and 300 m with a taxiway centre line lighting of 30 m across all lighting intensities.

5.3.28 Road-holding position light

Application

5.3.28.1 A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of~~350~~ 300 m.

5.3.28.2 **Recommendation.—** *A road-holding position light should be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between~~350~~ 300 m and 550 m.*

Origin: ADOP-WG/2, VAWG/16, ADOP/4	*Rationale* A study performed in a certified simulator provided evidence that flight crew could maintain positive centre line guidance in conditions down to 300 m RVR on taxiways originally designed to 350 m RVR specifications. This analysis extends to road-hold position lights as they are emulating the function of a stop bar (when controlled) or as a warning (when flashing). Mathematical comparisons also indicated that the human eye was not able to identify the difference between an RVR of 350 m and 300 m with a taxiway centre line lighting of 30 m across all lighting intensities. This principle also applied to other aerodrome visual aids currently linked to a 350 m RVR value.

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5.4 Signs

5.4.1 General

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Characteristics

5.4.1.3 Signs shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. The installed height of the sign shall not exceed the dimension shown in the appropriate column of Table 5-5~~.~~, except for runway distance remaining signs (see 5.4.8).

. . .

Insert new text as follows:

5.4.8 Runway distance remaining signs

Origin: VAWG/18/19/20, ADOP-WG/5, ADOP/4	*Rationale* The lack of pilot positional awareness during take-off and landing has been determined to be a contributing factor to runway excursions. Runway excursions are a common problem associated with aviation accidents, therefore aerodrome operators must create a safe environment within the airfield for the operation of aircraft to minimize the risks of runway excursions and their consequences. Runway distance remaining signs provide enhanced situational awareness for pilots in all visibility conditions, particularly since they reduce the time it takes

	pilots to determine the remaining runway distance available from the beginning to the end of the runway, during take-off or landing operations. The benefit of runway distance remaining signs to pilot situational awareness has been well established in existing installations at a large number of airports in at least 40 States. Following precedents in Annex 14, Volume I concerning the provision of certain airfield infrastructure and facilities such as clearways, stopways and Autonomous Runway Incursion Warning System (ARIWS) which are optional, it is proposed that the provisions related to *runway distance remaining signs* (RDRS) be not made mandatory but, where provided and installed (see Note 1), standardized specifications for location and characteristics shall comply with the specifications below, with further guidance available in the *Aerodrome Design Manual* (Doc 9157), Part 4.

Note 1.— The inclusion of detailed specifications for runway distance remaining signs (RDRS) in this section is not intended to imply that an RDRS has to be provided. Attachment A, Section 23, provides guidance on the need to provide RDRSs. Guidance on installing RDRSs is given in the Aerodrome Design Manual *(Doc 9157), Part 4.*

Note 2.— Runway excursions may take place in all visibility or weather conditions. The use of RDRS can form part of effective runway excursion prevention measures. The purpose of RDRSs is to provide pilots with distance-to-go information to the extremity of the runway, to enhance situational awareness and enable pilots to decide whether to commence a go-around or to apply braking action for more efficient roll-out and runway exit speeds. It is essential that pilots operating at aerodromes with RDRS be familiar with the purpose of these signs.

Note 3.— Provisions related to the identification of hazards and management of safety risks, including the need for safety risk assessment related to runway safety, is available in PANS-Aerodromes (Doc 9981), Chapter 8.

Location

5.4.8.1 Where provided, runway distance remaining signs (RDRS) shall be placed along the full length of the runway at longitudinal spacing of approximately 300 m, parallel and equidistant from the runway centre line.

Note.— Displaced threshold areas that are used for take-off and/or roll-out are treated as part of the runway for purposes of locating the signs.

5.4.8.2 Runway distance remaining signs shall be placed outside the edges of the runway at a distance shown in Table 5-6.

Characteristics

5.4.8.3 Where provided, an RDRS shall consist of an inscription in white on a black background.

5.4.8.4 The installed height of the RDRS shall not exceed the dimension shown in the appropriate column of Table 5-6. All RDRSs on one runway shall be the same size.

Table 5-6. Location distances for runway distance remaining signs

Sign height (mm)				Perpendicular distance from defined runway pavement edge to near side of sign
Code number	Legend	Face (min.)	Installed (max.)	
1 or 2	640	760	1070	6 – 10.5 m
3 or 4	1000	1200	1520	15 – 22.5 m
3 or 4	1200	1500	1600	25 m or more

End of new text.

….

Origin:	**Rationale:**
VAWG/19; ADOP/WG/5; ADOP/4	In Figure 5-7 Enhanced Taxiway Centre Line Marking, the depiction of a part of a taxiway centre line marking had been incorrectly indicated with a broken line. Upon investigation, it was confirmed that the lines in b) and d) should be indicated as a solid line, instead of a broken line and in e), a blank space instead of a line. With regards to Figure 5-10 Mandatory Instruction Marking, it was recalled that Amendment 14 to Annex 14, Volume I removed the use of outer main gear wheel span (OMGWS) in the categorisation of the various codes letter element in Table 1-1 ARC. These code letters were now based solely on the wingspan of various aeroplanes. With this change, taxiways which had been previously categorised in accordance to the code letters in Chapter 3, section 3.9, Annex 14, Volume I, are now categorised in accordance to the OMGWS of the various group of aeroplanes they were designed to operate. Consequently, there is a need to amend the captions used in Annex 14, Volume I, Chapter 5, Figure 5 -10. Amendment to Figure 5-15 stems from harmonization of lighting requirements for Cat II operations below 350 m.

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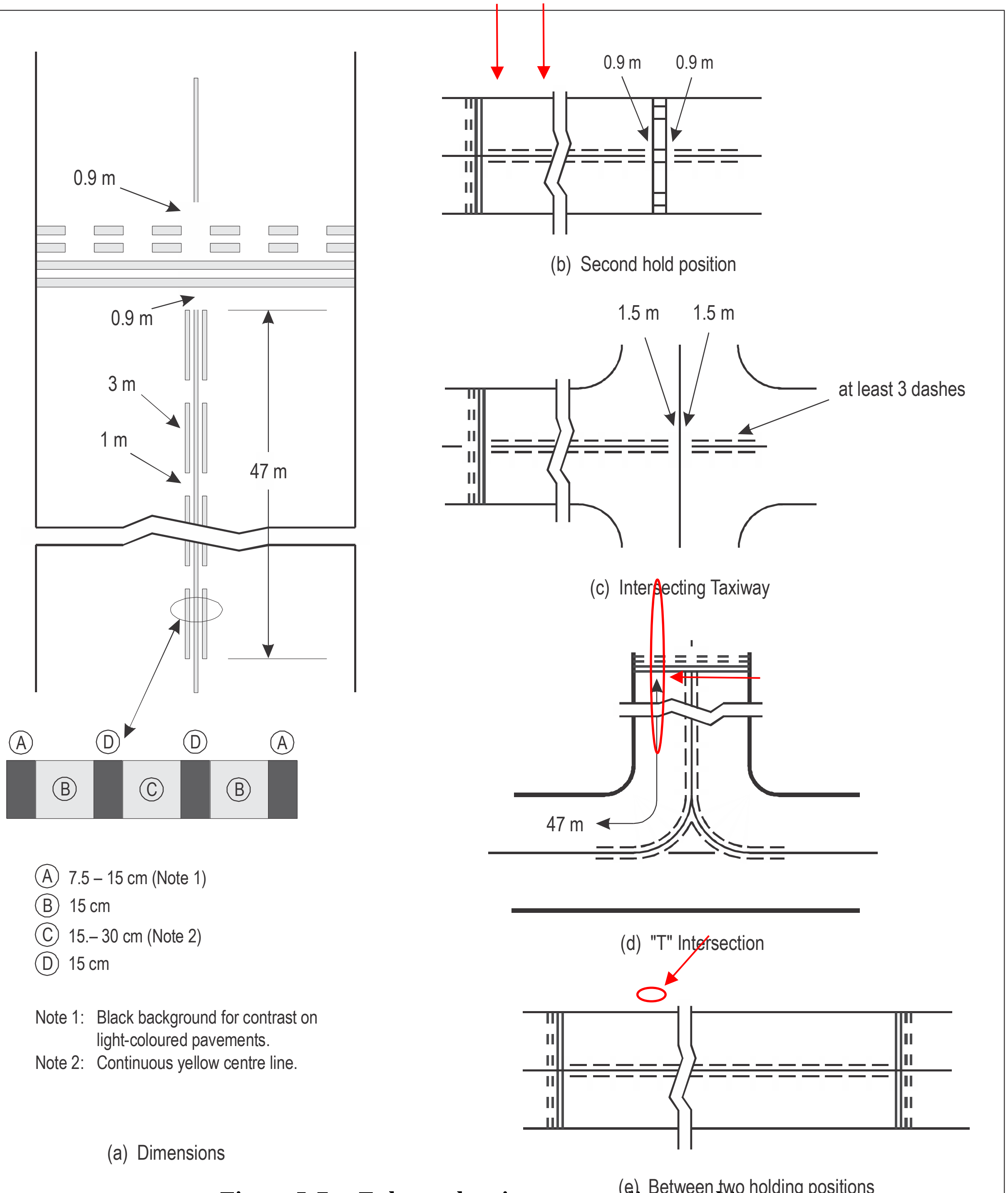

Figure 5-7. Enhanced taxiway centre line marking

. . .

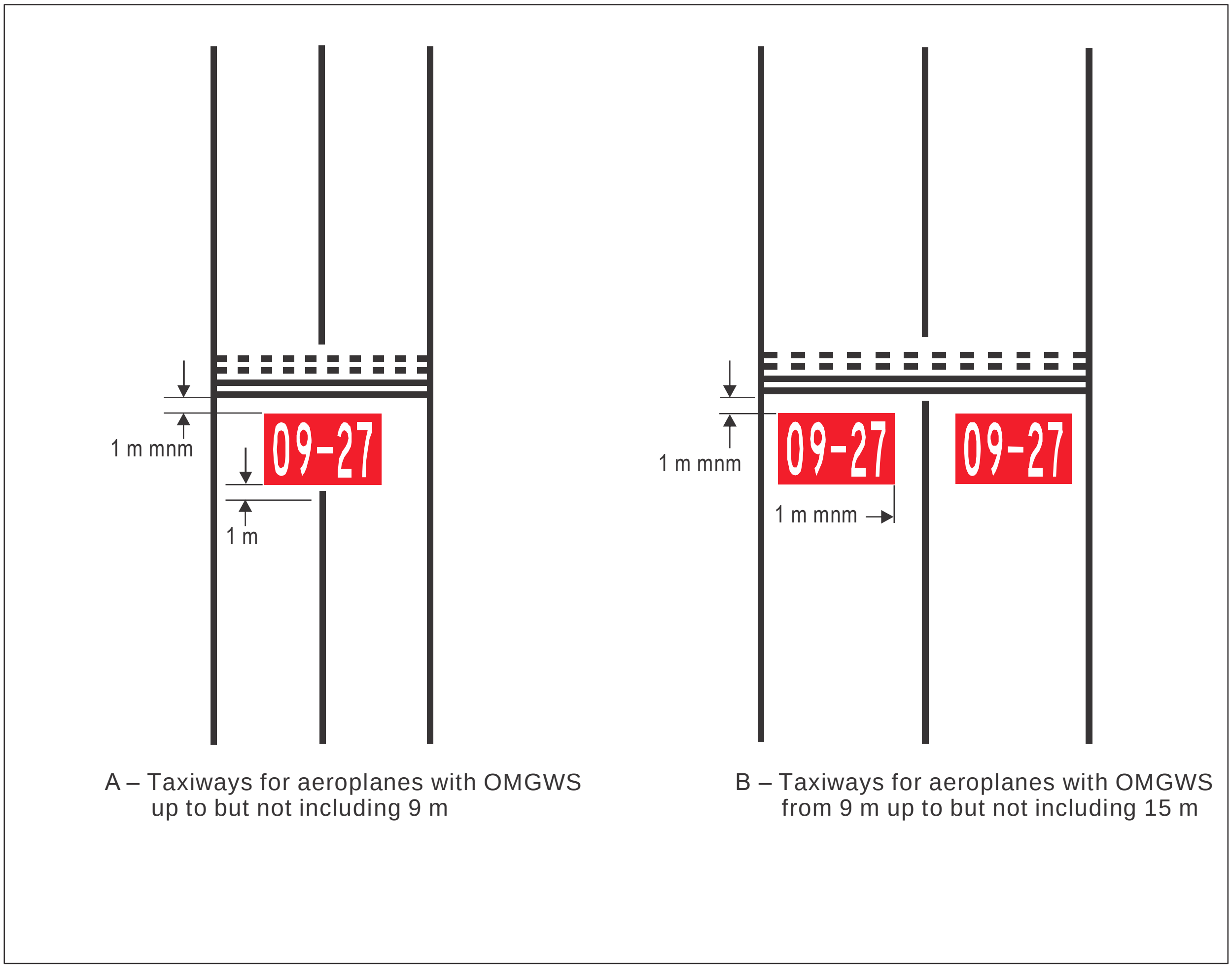

Figure 5-10. Mandatory instruction marking

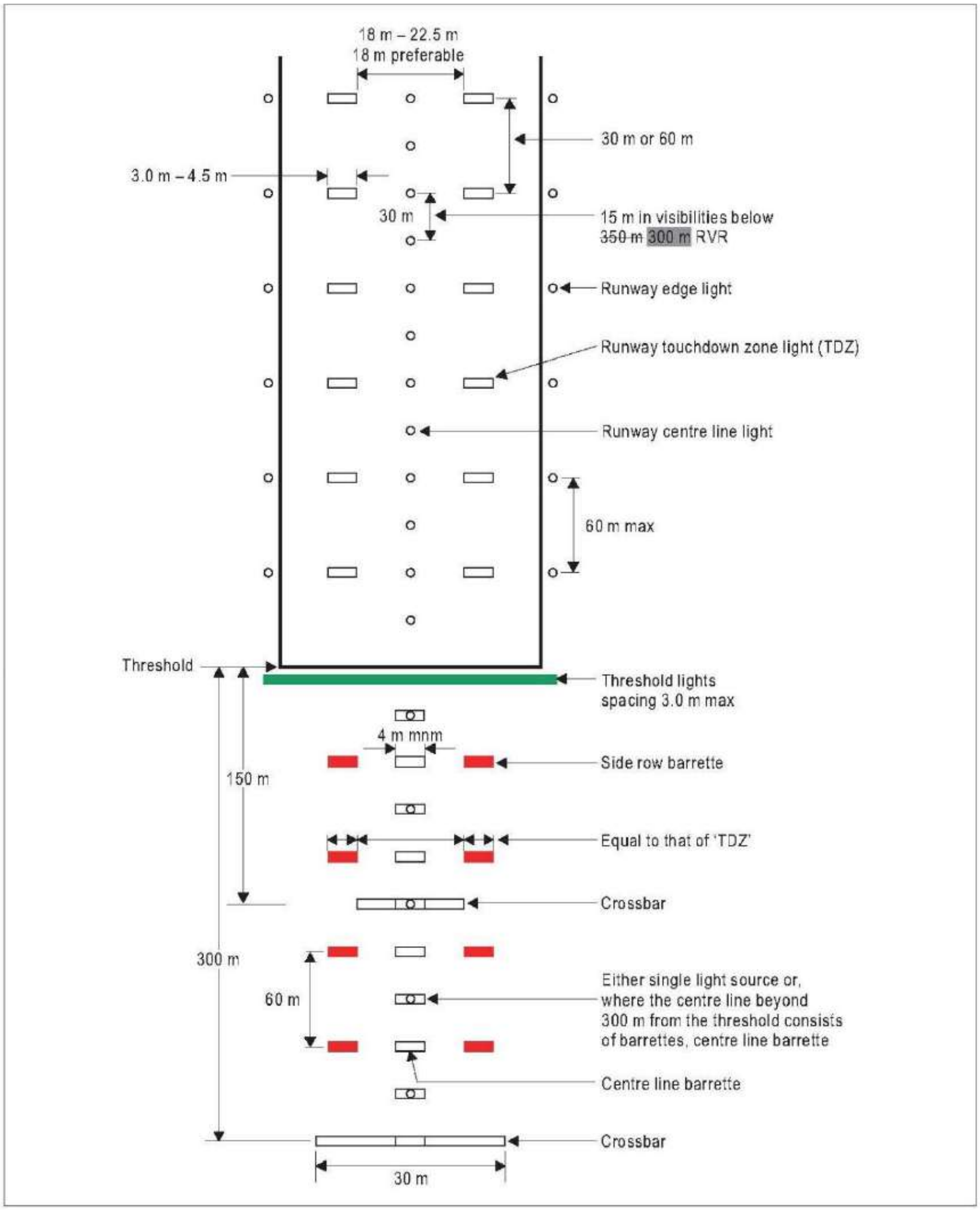

Figure 5-15. Inner 300 m approach and runway lighting for precision approach runways, categories II and III, where the serviceability levels of the lights specified as maintenance objectives in Chapter 10 can be demonstrated

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CHAPTER 10. AERODROME MAINTENANCE

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10.5 Visual aids

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10.5.1 A light shall be deemed to be unserviceable when the main beam average intensity is less than 50 per cent of the value specified in the appropriate figure in Appendix 2. ~~For light units where the designed main beam average intensity is above the value shown in Appendix 2, the 50 per cent value shall be related to that design value.~~ For light units where the main beam average intensity is required to be higher than the value specified in the appropriate figure in Appendix 2, a light shall be deemed to be unserviceable when the main beam average intensity value is less than 50 per cent of this higher value and not the value specified in Appendix 2.

Note.— Guidance on maintenance criteria for aeronautical ground lights, on the use of a site standard and on using a higher main beam average intensity is contained in the Aerodrome Design Manual *(Doc 9157), Part 4.*

Origin: VAWG/20, ADOP/04	*Rationale* Standard 10.5.1 is the only paragraph in Annex 14 and related documents where the term "design value" is used. It created uncertainty with authorities and aerodrome operators alike on its applicability and leads to different interpretations. The Standard is composed out of two parts or sentences. The first sentence defines serviceability for a light as a percentage of the minimum intensity values prescribed in Annex 14, Volume I, Appendix 2. The main beam average intensity of a light shall not be less than 50 per cent of the intensity value given in the appendix: this is for a lighting system where the initial new installation was done according to the intensity values. E.g.: if Annex 14, Volume I, Appendix 2 requires 10.000 cd (100 per cent), then a light should not measure below 5.000 cd (50 per cent). There is no issue in interpreting and applying this part of the Standard. The second sentence defines serviceability for a light where the aerodrome requires the aeronautical ground lights supporting runway operations to have a main beam average intensity that is higher than what is prescribed by Appendix 2. The term "designed", in this case refers to the aerodrome or "site" design of the lighting system, where an initial new installation of the aerodrome lighting system required higher intensity values than the intensity values prescribed by Appendix 2. In this case, the serviceability of 50 per cent for a light shall not refer to the minimum intensity value prescribed by Appendix 2, rather it shall refer to "that design value" being an initial higher intensity value. E.g. if Appendix 2 requires 10.000 cd as the minimum for an installation but the operator identifies the need for 15.000 cd (the new 100 per cent), then a light should not measure below 7.500 cd (the revised 50 per cent).

	Standard 10.5.1 does not need the term "design value"; it can be replaced by the terminologies used above and that of the first sentence of the Standard. A note will steer the reader to the guidance given by Doc 9157. This document supports Standard 10.5.1 and provides guidance on two subjects: the use of maintenance criteria for runway lights and how to maintain higher main beam average intensity lights.

. . .

10.5.8 The system of preventive maintenance employed for a stop bar provided at a runway-holding position used in conjunction with a runway intended for operations in runway visual range conditions less than a value of~~350~~ 300 m shall have the following objectives:

a) no more than two lights will remain unserviceable; and

b) two adjacent lights will not remain unserviceable unless the light spacing is significantly less than that specified.

10.5.9 The system of preventive maintenance employed for a taxiway intended for use in runway visual range conditions less than a value of~~350~~ 300 m shall have as its objective that no two adjacent taxiway centre line lights be unserviceable.

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APPENDIX 2. AERONAUTICAL GROUND LIGHT CHARACTERISTICS

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4. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-1. Isocandela diagram for approach centre line light and crossbars (white light)

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4. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-2. Isocandela diagram for approach side row light (red light)

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3. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-3. Isocandela diagram for threshold light (green light)

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3. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-4. Isocandela diagram for threshold wing bar light (green light)

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3. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-5. Isocandela diagram for touchdown zone light (white light)

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4. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-6. Isocandela diagram for runway centre line light with 30 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)

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4. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-7. Isocandela diagram for runway centre line light with 15 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)

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2. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-8. Isocandela diagram for runway end light (red light)

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5. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-9. Isocandela diagram for runway edge light where width of runway is 45 m (white light)

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5. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-10. Isocandela diagram for runway edge light where width of runway is 60 m (white light)

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Collective notes to Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27

. . .

~~4. Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average light intensity of the main beam of a new runway edge light shall be as follows:~~

4. The average intensity within the ellipse defining the main beam of a new light is established as a ratio of the minimum (1.0) average intensity of a new Runway edge light. The ratios also define the maximum allowed main beam average intensity for the lights in the lighting system supporting runway operations. Guidance on maintenance criteria for aeronautical ground lights and the use of a site standard is contained in the *Aerodrome Design Manual* (Doc 9157), Part 4.

Figure A2-1	Approach centre line and crossbars	~~1.5 to 2.0~~ 2.0 to 3.0 (white light)
. . .		
Figure A2-9	Runway edge (45 m runway width)	1.0 to 1.5 (white light)
Figure A2-10	Runway edge (60 m runway width)	1.0 to 1.5 (white light)

Origin:	*Rationale*
ADOP/4	Standard 10.5.1 refers to values specified in Annex 14, Volume I, Appendix 2. The part of this Appendix dealing with maintenance criteria for aeronautical ground lights is identified as an opportunity for improvement and should, in line with the changes to Annex 14, Volume I, 10.5.1 and Doc 9157, 19.2.18 Site standard, be amended so as to give a more appropriate explanation. Note 4 of the collective notes to Figures A2-1 to A2-11, A2-26 and A2-27 establishes values for aeronautical ground lights as a ratio of the minimum average intensity of a runway edge light, and is amended to correspond with the changes to 10.5.1 and 19.2.18 Site standard. The ratio given by Note 4 with Figure A2-1 does not correspond with the value in Figure A2-1. The figure requires a minimum average intensity of 20.000 cd, Note 4 requires a minimum average intensity of 1.5 times the minimum average intensity of a new Runway edge light (10.000 cd) which is only 15.000 cd. The note was amended to require a minimum of 2.0 times the minimum average intensity of a new runway edge light (10.000 cd) which is 20.000 and corresponds with the value in Figure A2-1.

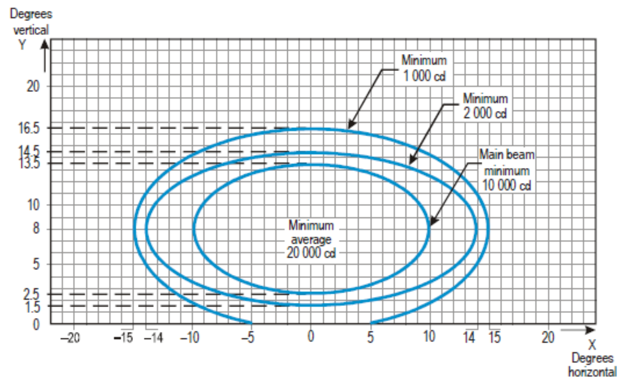

Figure A2-1. Isocandela diagram for approach centre line light and crossbars (white light)

	The acceptable maximum value of 2.0 given by Note 4 with Figure A2-1 should consequentially be amended since 2.0 is the minimum value according to Figure A2-1. Maintaining the current intensity difference of 1 to 2.66 (50 per cent of 1.5 to 2.0) would lead to a new ratio of 2.0 to 2.67. This maximum value of 2.67 is rounded to a value of 3.0. This will limit the intensity difference to 1 to 3 (50 per cent of 2.0 to 3.0). An acceptable value, since it is used for the threshold and using 3.0 and not 2.67 increases the ease of use of the ratios. The ratios given by Note 4 do not define a maximum intensity for the runway edge itself. It is important to define a maximum intensity for the runway edge. This will maintain uniformity between individual runway edge lights and maintain acceptable ratios with other lights to guarantee a uniform image of the lighting system supporting runway operations. The intensity difference used for the threshold, approach centre line and cross bars of 1 to 3 is used. Starting from the minimum value of 1.0 a maximum value of 1.5 for the runway edge is defined.

. . .

Figure A2-12. Isocandela diagram for taxiway centre line (15 m spacing), RELs, no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of~~350~~ 300 m where large offsets can occur and for low-intensity runway guard lights, Configuration B

. . .

Figure A2-13. Isocandela diagram for taxiway centre line (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of~~350~~ 300 m

. . .

Figure A2-14. Isocandela diagram for taxiway centre line (7.5 m spacing), RELs, no-entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of less than a value of~~350~~ 300 m

. . .

Figure A2-15. Isocandela diagram for taxiway centre line (30 m, 60 m spacing), no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of~~350~~ 300 m or greater

. . .

Figure A2-16. Isocandela diagram for taxiway centre line (7.5 m, 15 m, 30 m spacing), no-entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of ~~350~~ 300 m or greater

. . .

2. See collective notes for Figures A2-1 to A2-11, ~~and~~ A2-26 and A2-27.

Figure A2-26. Isocandela diagram for take-off and hold lights (THL) (red light)

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ATTACHMENT A. GUIDANCE MATERIAL SUPPLEMENTARY TO ANNEX 14, VOLUME I

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Insert new text as follows:

23. Runway distance remaining signs (RDRSs)

23.1 Runway distance remaining signs (RDRSs) do not have to be provided at all aerodromes. An aerodrome considering the installation of such signs may wish to assess their need individually, depending on factors such as runway length, aerodrome elevation, aerodrome geometry, traffic levels, lack of runway end safety area, lack of runway friction and climate.

23.2 RDRSs are placed along the full length of the runway at longitudinal spacing of 300 m (±30 m), parallel and equidistant from the runway centre line as in Configurations A, B or C, illustrated in Figure A-10. RDRSs are arranged by any of three different configurations as shown in Figure A-10.

23.3 In Configuration A, the RDRSs consist of double-faced signs and are located on both sides of the runway. Where the runway length is not an exact multiple of 300 m, the signs are placed at locations where the runway total length is divided equally.

23.4 In Configuration B, the RDRSs consist of double-faced signs and are located on both sides of the runway. Where the runway length is not an exact multiple of 300 m, one-half of the excess distance is added to the distance of each sign from each runway extremity. To illustrate the case where the distance between the end of the runway and the sign is the maximum, for a runway length of 1 950 m, the excess distance is 150 m and the location of the last sign on each runway end is 300 m plus one-half of 150 m, or 375 m. This configuration allows a maximum of 375 m at the end of the runway, but the other signs are exactly 300 m apart. The signs may be omitted on one side of the runway because of clearance conflict or by design.

Note.— For Configurations A and B, the signs may be omitted on one side of the runway because of clearance conflict or by design.

23.5 In Configuration C, the RDRSs consist of single-faced signs and are located on one side of each runway, viewed in the direction of take-off or landing. The advantage of Configuration C is that the runway distance remaining is more accurately reflected for a runway length that is not an exact multiple of 300 m.

23.6 An RDRS may be omitted if the sign cannot be placed within the tolerance of ±30 m.

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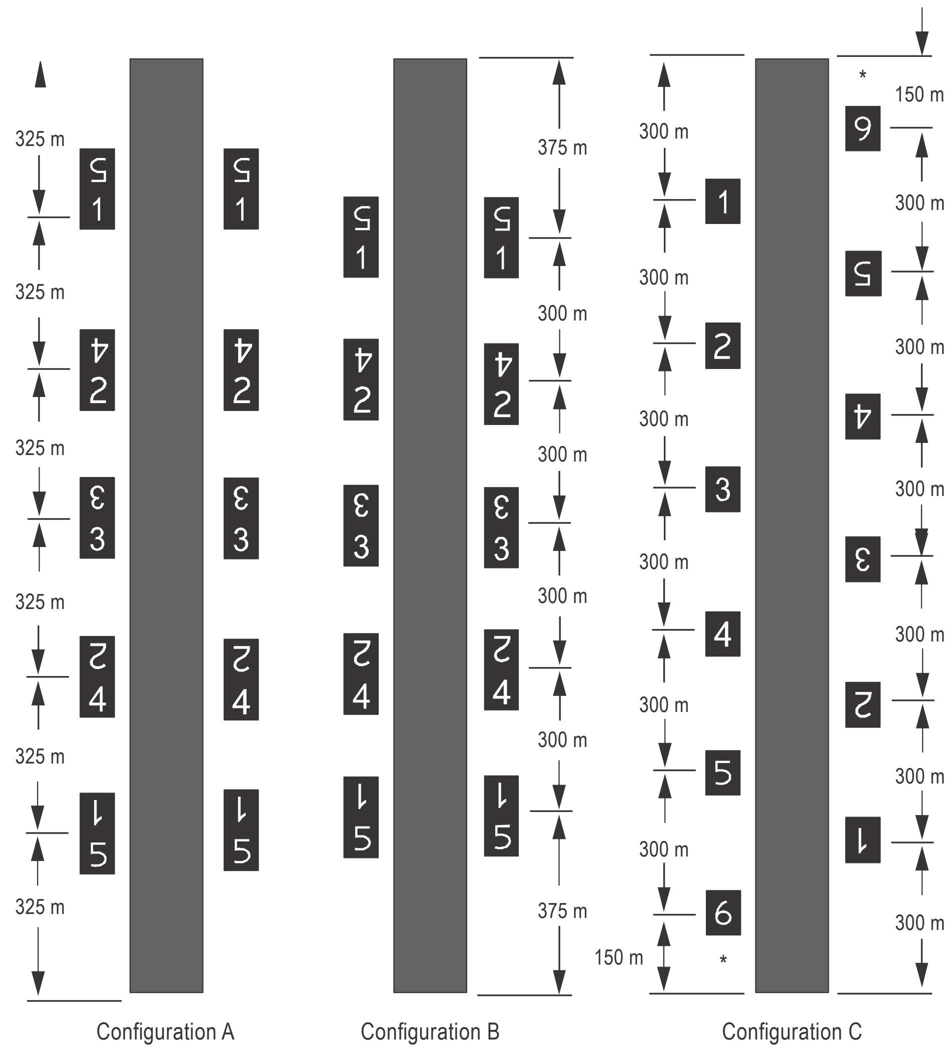

Note 1.— Examples based on a 1 950 m runway length.
Note 2.— Signs less than 300 m from take-off end, as indicated by asterisks(*) may be omitted.

Figure A-10. Runway distance remaining sign configurations

End of new text.

. . .

Origin	*Rationale*
VAWG/18/19/20, ADOP-WG/5, ADOP/4	The above guidance material complements the SARPs related to the provision of RDRS and are based on specifications that had been used at approximately 40 States and territories. Three different configurations have been described and the configuration chosen is based on cost consideration and adaptability to the specific airport layout. Further guidance are available in the *Aerodrome Design Manual,* Part 4 — *Visual Aids* (Doc 9157).

INITIAL PROPOSAL 6
Improved operational safety through enhanced visual aids to denote construction works at aerodromes

CHAPTER 5. VISUAL AIDS FOR NAVIGATION

. . .

5.4 Signs

. . .

5.4.3 Information signs

Note 1.— See Figure 5-31 for pictorial representations of information signs.

Note 2.— See Chapter 7, 7.4.3 for specifications related to unserviceability signs providing information on operational restrictions and construction works at aerodromes.

. . .

Origin	*Rationale*
ADOP/4	Note 2 refers to the availability of provisions related to unserviceability signs in Chapter 7.

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CHAPTER 7. VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS

7.1 Closed runways and taxiways or parts thereof

Origin	*Rationale*
VAWG/16 – 20; ADOP/4	During the past years, the aviation community faced several accidents and incidents due to construction works at aerodromes. Some of these safety events may have been prevented with enhanced visual cues. Although compliant aeronautical information is provided through the AIP, AIP Supplement or NOTAM, safety occurrence records have pointed at the fact that aircrews can miss this information and not be aware of the works in progress. There was an urgent need to develop provisions for the use of visual aids to denote temporary runway closure and any other temporary changes to the movement area of an operational aerodrome.

	Format change proposed: currently, Annex 14, Volume I, Section 7.1 contained a mixture of items involving markings, lightings for both runways and taxiways, all in one section. Accordingly, it was proposed to rearrange Section 7.1, using current format in Chapter 5, for better clarity: 7.1.1 General 7.1.2 Closed runway marking 7.1.3 Closed taxiway marking 7.1.4 Closed runway lighting 7.1.1.1 and 7.1.1.3 are respectively the same as existing 7.1.5 and 7.1.7. Section 7.1.1.2 was derived from existing 7.1.6, taking into account that lighting systems provided for a closed runway or taxiway or portion thereof may also be operated during snow removal operations or inspections of the movement area.

7.1.1 General

Editorial Note.— Relocate sections 7.1.5 to 7.1.7 under new 7.1.1 with modifications as indicated below.

~~7.1.5~~7.1.1.1 When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings shall be obliterated.

~~7.1.6~~7.1.1.2 Lighting ~~on~~ systems provided for a closed runway or taxiway or portion thereof shall not be operated, except as required for maintenance purposes or where operationally required.

Note.— Lighting systems provided for a runway include both approach and runway lighting systems.

~~7.1.7~~7.1.1.3 In addition to closed markings, as specified in 7.1.2, when ~~the~~ a closed runway or taxiway or portion thereof is intercepted by a~~usable~~ runway or taxiway which ~~is~~ can be used at night, unserviceability lights shall be placed across the entrance to the closed area at intervals not exceeding 3 m (see 7.4.~~4~~2).

7.1.2 Closed runway marking

Origin: ADOP/4	*Rationale* Proposed 7.1.2.1 to 7.1.2.4 were derived from existing 7.1.1 to 7.1.4 and apply to closed runway marking only.

Editorial Note.— *Relocate* sections 7.1.1 to 7.1.4 below as new 7.1.2 with modifications as indicated.

Application

~~7.1.1~~7.1.2.1 A closed runway marking shall be displayed on a runway ~~or taxiway~~ or portion thereof which is permanently closed to the use of all aircraft.

~~7.1.2~~7.1.2.2 **Recommendation.—** *A closed runway marking should be displayed on a temporarily closed runway~~or taxiway~~ or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.*

Location

~~7.1.3~~7.1.2.3 ~~On a runway a~~ A closed runway marking shall be placed at each~~end~~ extremity of the runway, or portion thereof, declared closed, and additional markings shall be so placed that the maximum interval between markings does not exceed 300 m. ~~On a taxiway a closed marking shall be placed at each end of the taxiway or portion thereof closed.~~

Characteristics

~~7.1.4~~7.1.2.4 The closed runway marking shall be white and of the form and proportions as detailed in Figure 7-1, Illustration a)~~, when displayed on a runway, and shall be of the form and proportions as detailed in Figure 7-1, Illustration b), when displayed on a taxiway. The marking shall be white when displayed on a runway and shall be yellow when displayed on a taxiway~~.

Note 1.— When an area is temporarily closed, frangible barriers or markings utilizing materials other than paint or other suitable means may be used to identify the closed area.

Note 2. — Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

7.1.3 Closed taxiway marking

Origin: ADOP/4	*Rationale* Sections 7.1.3.1 to 7.1.3.4 are derived from existing 7.1.1 to 7.1.4 and apply to closed taxiway marking only.

Editorial Note.— Duplicate and relocate sections 7.1.1 to 7.1.4 under new 7.1.3 with modifications as indicated.

Application

~~7.1.1~~7.1.3.1 A closed taxiway marking shall be displayed on a ~~runway or~~ taxiway or portion thereof which is permanently closed to the use of all aircraft.

~~7.1.2~~7.1.3.2 **Recommendation.—** *A closed taxiway marking should be displayed on a temporarily closed~~runway or~~ taxiway or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.*

Location

7.1.37.1.3.3 On a runway a closed marking shall be placed at each end of the runway, or portion thereof, declared closed, and additional markings shall be so placed that the maximum interval between markings does not exceed 300 m. On a A closed taxiway a closed marking shall be placed at least at each endextremity of the taxiway or portion thereof closed.

Characteristics

7.1.47.1.3.4 The closed taxiway marking shall be yellow and of the form and proportions as detailed in Figure 7-1, Illustration ab)., when displayed on a taxiway. The marking shall be white when displayed on a runway and shall be yellow when displayed on a taxiway.

Note 1.— When an area is temporarily closed, frangible barriers or markings utilizing materials other than paint or other suitable means may be used to identify the closed area.

Note 2.— Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

Editorial Note.— Relocate Figure 7-1 below 7.1.3.4, Note 2.

7.1.4 Closed runway lighting

Origin: ADOP/4	*Rationale* Although compliant aeronautical information on the works in progress are provided through the AIP, AIP Supplement or NOTAM, aircrew may miss this information and not be aware of the works in progress, especially at an aerodrome provided with runway lighting. At this type of aerodrome, the use of runway closed lighting on a temporarily closed runway in addition to the publication of compliant aeronautical information is recommended in order to enhance the conspicuity of the runway closure for the pilot.

Application

7.1.4.1 **Recommendation.**— *Where operationally desirable, closed runway lighting should be provided on a temporarily closed runway at an aerodrome provided with runway lighting.*

Note 1.— In dusk or poor visibility conditions by day, lighting can be more effective than markings.

Note 2.— The closed runway lighting is intended to be controlled either automatically or manually by air traffic services or by the aerodrome operator.

Origin: ADOP/4	*Rationale* The study led by the United States, was conducted in daytime as well as night-time VMC. Closed runway lighting is intended to reduce instances of aircraft landing on temporarily closed runways. The likelihood of unintended landings increased during periods of poor daytime visibility and at night whenever runway lighting must be switched on for electrical maintenance or snow removal.

Location

7.1.4.2 A closed runway lighting shall be placed on the centre line, at each extremity of the runway temporarily declared closed.

Note.— Placement of a closed runway lighting on the runway designation marking would enhance the situational awareness of the runway closure to the pilot.

Characteristics

7.1.4.3 The closed runway lighting as viewed by the pilot shall be of the equivalent elevated form and proportions as detailed in Figure 7-2, showing a minimum of five lights uniformly spaced on each branch, with a minimum interval as specified by Table 7-1.

Table 7-1. Minimum interval between closed runway lights centres

Number of lights per branch	Minimum interval between lights centres
5	1.5 m
7	1.0 m
9	0.8 m

Note 1.— The closed runway lighting may be either fixed or mobile.

Note 2.— The fixed closed runway lighting may be formed as if shadowed (i.e. stretched) from the equivalent elevated structure (see Appendix 3, Note 3). Guidance on the sizing of a fixed closed runway lighting is given in the Aerodrome Design Manual *(Doc 9157), Part 4.*

Editorial Note.— Insert new Figure 7-2

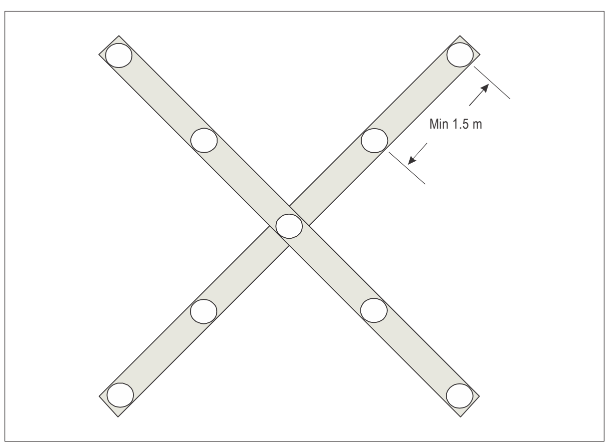

Figure 7-2. Example of equivalent elevated closed runway lighting with five lights per branch

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Editorial Note.— Renumber subsequent figures as needed.

Origin: ADOP/4	*Rationale* Experiments carried out in the United States proved that 1.5 NM was a sufficient recognition distance to recognize the shape for closed runway lighting in VMC conditions. Closed runway lights shall be uniformly spaced on each branch at the minimum stated spacing intervals in order to ensure recognition of shape. Provided the branches' length remained within the minimum stated, the pilot's ability to recognize the shape of a cross increased with the number of closed runway lights per branch. In the case of five closed runway lights per branch, a minimum interval of 1.5 m between lights centres was necessary for the human eye to perceive each closed runway light separately from a distance of 1.5 NM. The minimum viewing angle at which two distant objects could be perceived as separate by the human eye equals two minutes of arc.

7.1.4.4 Closed runway lights shall show flashing variable white in the direction of approach to the runway, at a rate of one second on and one second off.

7.1.4.5 Closed runway lights shall automatically revert to fixed lights in the event of the flashing system failure.

7.1.4.6 Closed runway lights shall be in accordance with the specifications in Appendix 2, Figure A2-27.

Origin: ADOP/4	*Rationale* Experiments carried out in the United States demonstrated that the use of flashing, rather than steady burning, white lights resulted in a greater conspicuity of, and drawing the attention of pilots to, the closed runway lighting when viewed from the air, compared to the use of red lights. The proposed flash rate has been adopted from the characteristics of runway guard lights (Annex 14, Volume 1, 5.3.23.19 refers). Closed runway lighting, if provided in accordance with 7.1.8, shall not be turned off in the event of a failure of the flashing system.

. . .

7.4 Unserviceable areas

Origin: ADOP/4	*Rationale* Currently, Annex 14, Volume I, section 7.4 contains provisions related to a mixture of markers, lightings, cones, flags and marker boards. It is proposed to rearrange 7.4, in line with the structure used in Chapter 5, as follow: 7.4.1 Unserviceability markings 7.4.2 Unserviceability lights 7.4.3 Unserviceability signs 7.4.4 Unserviceability markers

Insert new text as follows:

7.4.1 Unserviceability markings

Application

7.4.1.1 **Recommendation.—** *Where operationally required, unserviceability signs should be supplemented by unserviceability markings on the surface of the pavement.*

Origin: ADOP/4	*Rationale* Section 7.4.1.1 was derived from 5.2.16.2 which applies to mandatory instruction marking. Unserviceability signs should be supplemented by unserviceability markings on the surface of the pavement where there is an operational need to indicate temporary changes to taxiways and aprons.

7.4.1.2 Where it is impracticable to install an unserviceability sign in accordance with 7.4.3.1, an unserviceability marking shall be provided on the surface of the pavement.

Origin: ADOP/4	*Rationale* Section 7.4.1.2 was derived from 5.2.16.1 which applies to mandatory instruction marking. An unserviceability marking shall be provided where it is impracticable to install an unserviceability sign and where there is an operational need to indicate temporary changes to runway declared distances.

Location

7.4.1.3 **Recommendation.—** *Unserviceability markings should be displayed across the surface of the taxiway or apron where necessary and positioned so as to be legible from the cockpit of an approaching aircraft.*

Origin:	*Rationale*
ADOP/4	Section 7.4.1.3 is the same as 5.2.17.5 which applies to information marking.

Characteristics

7.4.1.4 Unserviceability markings shall consist of an inscription in black upon an orange background.

7.4.1.5 **Recommendation.—** *The character height should be 4 m. The inscriptions should be in the form and proportions shown in Appendix 3.*

Origin	*Rationale*
ADOP/4	7.4.1.5 is the same as 5.2.17.8 which applies to information marking.

7.4.1.6 **Recommendation.—** *The background should be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription.*

Origin	*Rationale*
ADOP/4	7.4.1.6 is the same as 5.2.16.10 which applies to mandatory instruction marking.

End of new text.

Editorial Note.— Relocate Section 7.4 under new 7.4.2, with modifications.

~~7.4 Unserviceable areas~~

7.4.2 Unserviceability lights

Application

~~7.4.1~~ 7.4.2.1 Unserviceability~~markers~~ lights shall be~~displayed~~ provided on a movement area used at night, wherever any portion of~~a taxiway, apron or holding bay~~ the movement area is unfit for the movement of aircraft but it is still possible for aircraft to bypass the area safely. ~~On a movement area used at night, unserviceability lights shall be used.~~

Note 1.— Unserviceability~~markers and~~ lights are used for such purposes as warning pilots of a hole in a taxiway or apron pavement or outlining a portion of pavement, such as on an apron, that is under repair. They are not suitable for use when a portion of a runway becomes unserviceable, nor on a taxiway when a major portion of the width becomes unserviceable. In such instances, the runway or taxiway is normally closed.

Note 2.— Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

Location

~~7.4.2~~ 7.4.2.2 Unserviceability~~markers and~~ lights shall be placed at intervals sufficiently close so as to delineate the unserviceable area.

Note.— Guidance on the location of unserviceability lights is given in Attachment A, Section 13.

~~Characteristics of unserviceability markers~~

~~7.4.3 Unserviceability markers shall consist of conspicuous upstanding devices such as flags, cones or marker boards.~~

Characteristics ~~of unserviceability lights~~

~~7.4.4~~ 7.4.2.3 An unserviceability light shall consist of a red fixed light. The light shall have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which it would normally be viewed. In no case shall the intensity be less than 10 cd of red light.

Insert new text as follows:

7.4.3 Unserviceability signs

Note 1.— Temporary changes to the movement area may include, inter alia, reduction in the runway length, reduction in the maximum allowable wingspan, taxiway closure or any other closure to the movement area. Unserviceability signs provide relevant information to aerodrome users to maintain an acceptable level of safety during aircraft and vehicle operations, by reducing the risk of confusion and enhancing the awareness of such temporary changes.

Note 2.— Unserviceability signs can be used to indicate temporary closed or restricted areas, as well as to provide information on operational restrictions to aerodrome users.

Origin: ADOP/4	*Rationale* Unserviceability signs as means of risk mitigation during temporary changes to the movement area (reduction in the runway length, reduction in the maximum allowable wingspan, taxiway closure or any other closure to the movement area) was assessed on several airports in Europe and in the United States. The results showed acceptance and comprehension by pilots, while also portraying safety benefits (decrease in the rate of misleading operations). The new Standard pertaining to unserviceability signs, where there is an operational need to indicate temporary changes to runway declared distances, strongly mitigates the risk of using the wrong TORA value for take-off. The provision of unserviceability signs where there is an operational need to indicate temporary changes to taxiways and aprons, is only a recommendation as the safety impact of such a change may not be as high as that of the use of a wrong TORA value. Existing signs providing inadequate or misleading information as a consequence of temporary changes to the movement area shall be removed or obscured in order to avoid any confusion with the appropriate messages conveyed by unserviceability signs.

Application

7.4.3.1 Unserviceability signs shall be provided where there is an operational need to indicate temporary changes to runway declared distances.

7.4.3.2 **Recommendation.—** *Unserviceability signs should be provided where there is an operational need to indicate temporary changes to taxiways and aprons.*

7.4.3.3 Existing signs shall be removed or obscured at an aerodrome if they provide inadequate or misleading information regarding unserviceability areas.

7.4.3.4 The information provided by unserviceability signs shall not be in conflict with the information provided by the appropriate aeronautical information services.

Note .— The information provided by unserviceability signs supplements that which is provided by the appropriate aeronautical information services unit.

Location

7.4.3.5 Unserviceability signs shall be located where operationally needed on the movement area. The location distances on the manoeuvring area shall be as per taxiing guidance signs in Table 5-5.

7.4.3.6 The location of unserviceability signs shall not visually obscure or provide conflicting information with existing operationally required visual aids.

Characteristics

7.4.3.7 Unserviceability signs shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. The installed height of unserviceability signs shall not exceed the dimension for taxiing guidance signs shown in Table 5-5.

7.4.3.8 Unserviceability signs shall be rectangular, as shown in Figure 7-4, with the longer side horizontal.

7.4.3.9 The inscriptions on an unserviceability sign shall be in accordance with the provisions of Appendix 4.

Origin: ADOP/4	*Rationale* Surveys conducted in both the United States and Europe showed that using the same dimensions and typography for unserviceability signs and information signs provided good results in terms of legibility and comprehension. As such, sections 7.4.3.7 to 7.4.3.9 largely relate to 5.4.1.3, 5.4.1.4 and 5.4.1.6, which apply to signs.

7.4.3.10 Unserviceability signs shall consist of an inscription in black on an orange background. Unserviceability signs shall be supplemented by a black outline measuring 10 mm in width for runways where the code number is 1 or 2, and 20 mm in width for runways where the code number is 3 or 4.

Origin: ADOP/4	*Rationale* Surveys conducted in both the United States and Europe showed that the orange colour used for unserviceability signs was easily understood by pilots and drivers as it was internationally used for road signs to denote road construction works. The use of orange when indicating unusual activities was also reported to be easily distinguishable from the yellow used for information signs.

7.4.3.11 The inscription on an unserviceability sign shall consist of a legible, clear and simple message, only providing the useful and necessary information for the safety of the operation.

Note.— See Figure 7-3 for examples of unserviceability signs.

7.4.3.12 Unserviceability signs shall be retroreflective in accordance with the provisions of Appendix 4.

Origin: ADOP/4	*Rationale* The need for illuminated vis-à-vis retroflective signs was extensively discussed. Although these signs are runway- and safety-related and thus should be illuminated, other factors such as: a) signs being temporary in duration; a) obviate the need for power supply and maintenance; and b) financial costs, had been taken into consideration. On balance, it was felt that these signs needed to be retroflective in order for them to be both simple and cost-effective to install.

7.4.3.13 **Recommendation.—** *Where there is a need to enhance the conspicuity of unserviceability signs, they should be supplemented by two red or yellow simultaneously flashing lights. The intensity and the beam spread of these lights should be in accordance with the specifications in Appendix 2, Figure A2-24.*

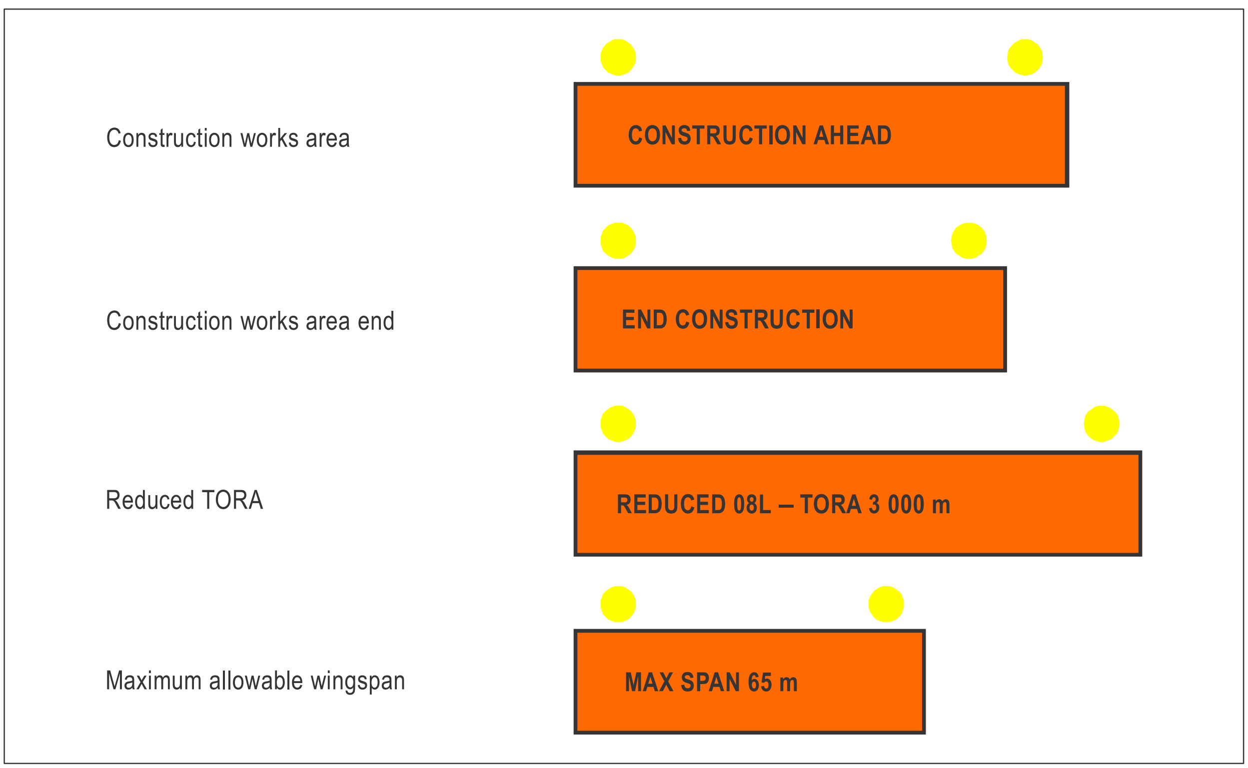

Figure 7-3. Examples of unserviceability signs

7.4.4 Unserviceability markers

Application

7.4.4.1 Unserviceability markers shall be displayed wherever any portion of a taxiway, apron or holding bay is unfit for the movement of aircraft but it is still possible for aircraft to bypass the area safely.

Note.— Unserviceability markers are used for such purposes as warning pilots of a hole in a taxiway or apron pavement or outlining a portion of pavement, such as on an apron, that is under repair. They are not suitable for use when a portion of a runway becomes unserviceable, nor on a taxiway when a major portion of the width becomes unserviceable. In such instances, the runway or taxiway is normally closed.

Location

7.4.4.2 Unserviceability markers shall be placed at intervals sufficiently close, so as to delineate the unserviceable area.

Characteristics

7.4.4.3 Unserviceability markers shall consist of conspicuous upstanding devices such as flags, cones or marker boards.

End of new text.

~~Characteristics of unserviceability cones~~

~~7.4.5~~ 7.4.4.4 **Recommendation.—** *An unserviceability cone should be at least 0.5 m in height and red, orange or yellow or any one of these colours in combination with white.*

~~Characteristics of unserviceability flags~~

~~7.4.6~~ 7.4.4.5 **Recommendation.—** *An unserviceability flag should be at least 0.5 m square and red, orange or yellow or any one of these colours in combination with white.*

~~Characteristics of unserviceability marker boards~~

~~7.4.7~~ 7.4.4.6 **Recommendation.—** *An unserviceability marker board should be at least 0.5 m in height and 0.9 m in length, with alternate red and white or orange and white vertical stripes.*

CHAPTER 8. ELECTRICAL SYSTEMS

8.1 Electrical power supply systems for air navigation facilities

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Visual aids

Application

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8.1.10 **Recommendation.—** *The following aerodrome facilities should be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:*

. . .

c) approach, runway and taxiway lighting as specified in~~8.1.6 to~~ 8.1.9;

d) closed runway lighting, if provided in accordance with 7.1.4.1 and connected to the primary power supply;

~~d~~e) meteorological equipment;

~~e~~f) essential security lighting, if provided in accordance with 9.11;

~~f~~g) essential equipment and facilities for the aerodrome responding emergency agencies;

~~g~~h) floodlighting on a designated isolated aircraft parking position if provided in accordance with 5.3.24.1;and

~~h~~i) illumination of apron areas over which passengers may walk.

Note.— Specifications for secondary power supply for radio navigation aids and ground elements of communications systems are given in Annex 10, Volume I, Chapter 2.

Origin: ADOP/4	*Rationale* Reference to 8.1.6, 8.1.7 and 8.1.8 is proposed to be deleted since: a) as a recommendation, it conflicts with 8.1.6 and 8.1.7 which are Standards; and b) the intent of 8.1.10 is already covered in existing 8.1.8.

. . .

8.2 System design

. . .

8.2.4 The electrical systems for the power supply and the control of the closed runway lighting shall be so designed that the closed runway lighting system is operated independently of runway lighting systems.

Origin: ADOP/4	*Rationale* Runway lighting shall not be operated at the same time as closed runway lighting, if provided in accordance with 7.1.8, except for maintenance purposes or where operationally required.

. . .

APPENDIX 2. AERONAUTICAL GROUND LIGHT CHARACTERISTICS

. . .

Figure A2-24. Isocandela diagram for each light in low-intensity runway guard lights, Configuration A and for flashing lights supplementing unserviceability signs

Origin: ADOP/4	*Rationale* In accordance with Recommendation 7.4.3.12, unserviceability signs should be supplemented by two red or yellow flashing lights, where there is a need to enhance their conspicuity. The intensity and the beam spread of these lights should be in accordance with the specifications in Appendix 2, Figure A2-24.

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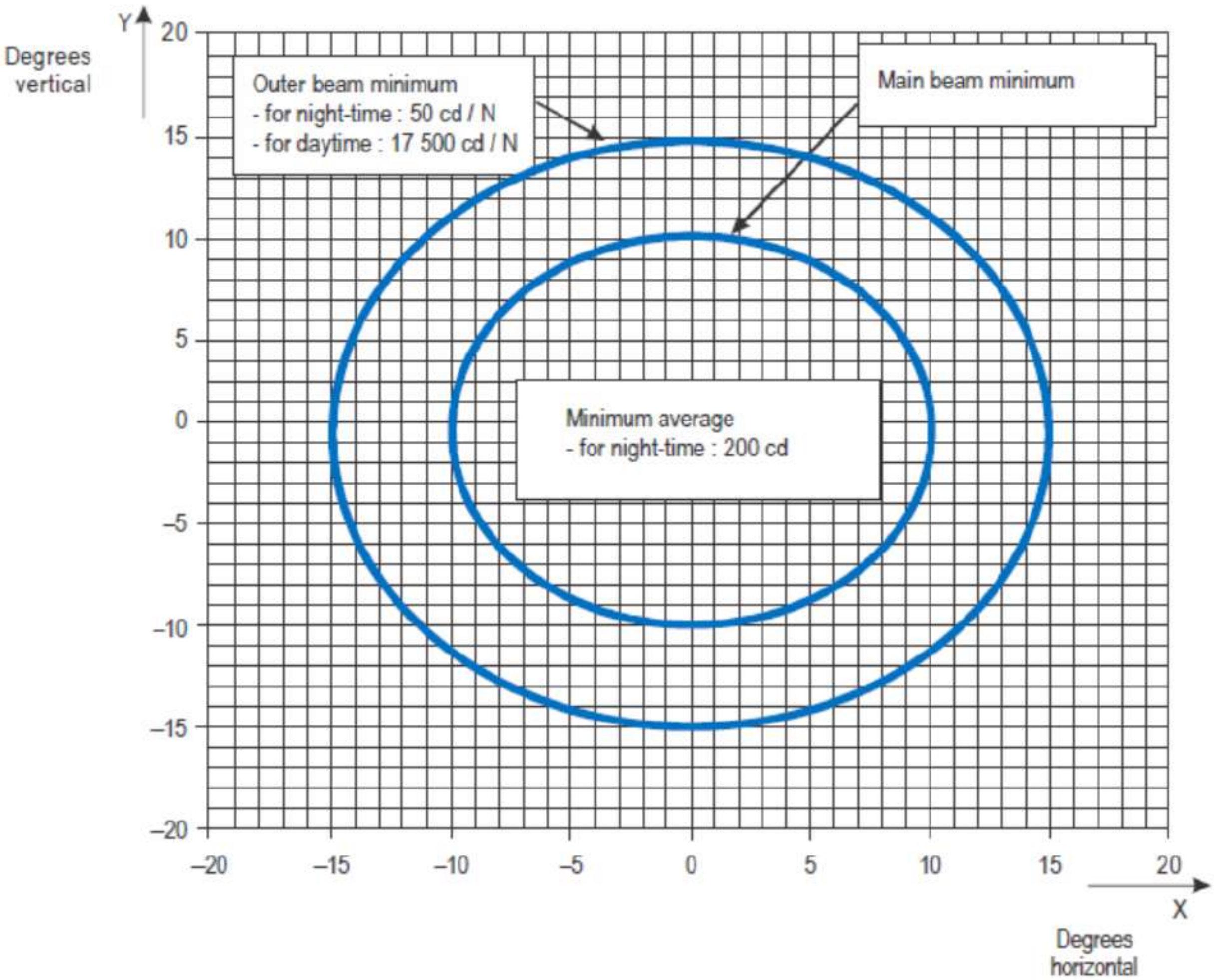
Editorial Note.— Insert new figure.



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

b	10	15

2. N is the total number of lights of the closed runway lighting.
3. See collective notes for Figures A2-1 to A2-11, A2-26 and A2-27.

Figure A2-27. Isocandela diagram for closed runway lights (white light)

Origin:	*Rationale*
ADOP/4	Results of experiments carried out in the United States (see report https://www.tc.faa.gov/its/worldpac/techrpt/cttn87-3.pdf) using several prototype systems, indicated that the array selected – nine spotlights in the shape of the letter " X" – provided an intuitive indication of a closed runway in adequate time for a pilot to

	execute a safe missed approach, effective during both straight-in and circling approaches. These experiments were the basis for the sizing of the isocandela curves and the minimum intensities of closed runway lights. These experiments also showed that at night, utilizing the daytime minimum light intensity, although making it easily acquired, the closed runway lighting was too bright and the blooming of the individual lights obscured the shape recognition of the closed runway lighting. It was showed that reducing the minimum night-time light intensity to a calculated value, based on the night-time illuminance threshold of the human eye resulted in a better acquisition of the closed runway lighting. The minimum day-time and night-time average intensities required for the main beam of the closed runway lighting are set at respectively 70 000 cd and 200 cd, giving, from Allard's law, acquisition distances of respectively 2,7 NM and 1,8 NM in visual meteorological conditions (VMC) i.e. in visibility conditions of 3 SM. The 70 000 cd value has already been validated by the experiments in the United States. Preliminary findings in the ongoing study showed that the current night-time minimum intensities were too high and should be reduced to 200 cd to better identify the shape of the closed runway lighting. The minimum day-time and night-time average intensities required for the main beam of a single closed runway light are obtained by dividing those of the closed runway lighting by its total number of lights. The minimum daytime and night-time local intensities required for the main beam and the outer beam of a single closed runway light are then deduced. In VMC conditions, beyond 1.5 NM, closed runway lights are perceived as amalgamated and the closed runway lighting is perceived as a single luminous source. Therefore, the luminous intensities of the individual closed runway lights add up.

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APPENDIX 4. REQUIREMENTS CONCERNING DESIGN OF ~~TAXIING GUIDANCE~~ SIGNS

~~*Note.— See Chapter 5, Section 5.4, for specifications on the application, location and characteristics of signs.*~~

Origin: ADOP/4, Job Card ADOP011 and ADOP021	*Rationale* The title of Appendix 4 is proposed to be changed since the specifications are not limited to just taxiing guidance signs, but also to RDRS in Chapter 5, 5.4.8 and unserviceable areas in Chapter 7, 7.4.

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PROPOSED AMENDMENT TO

PROCEDURES FOR AIR NAVIGATION SERVICES — AERODROMES

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT

The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

1.	~~Text to be deleted is shown with a line through it.~~	text to be deleted
2.	New text to be inserted is highlighted with grey shading.	new text to be inserted
3.	~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading.	new text to replace existing text

PROPOSED AMENDMENT TO

PROCEDURES FOR AIR NAVIGATION SERVICES — AERODROMES

(PANS-AERODROMES, Doc 9981)

INITIAL PROPOSAL 1
Obstacle limitation surfaces at aerodromes

TABLE OF CONTENTS

. . .

PART II — AERODROME OPERATIONAL MANAGEMENT

. . .

FOREWORD

. . .

6. CONTENTS OF THE DOCUMENT

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PART II — AERODROME OPERATIONAL MANAGEMENT

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6.19 **Part II, Chapter 10 — Obstacle Evaluation and Control**
(Applicable as of 23 November 2028)

6.19.1 This chapter contains provisions pertaining to obstacle limitation surfaces and aeronautical study. It deals with topics on selection of required obstacle limitation surfaces, comprising obstacle free surfaces and obstacle evaluation surfaces, and how these surfaces can be adjusted to match the type of operations provided at an aerodrome. In addition, the chapter provides guidance on how to conduct aeronautical study.

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ACRONYMS AND ABBREVIATIONS

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ADG Aeroplane design group[1]

. . .

AT-VASIS Abbreviated T visual approach slope indicator system*

. . .

CNS Communications, navigation, and surveillance

OES Obstacle evaluation surface*

OFS Obstacle free surface*

. . .

LNAV Lateral navigation*

MLS Microwave landing system

NPA Non-precision approach procedures

OCA/H Obstacle clearance altitude/height

RNP Required navigation performance*

SBAS Satellite-based augmentation system

SDF Step-down fixes*

. . .

TOD Terrain obstacle datasets*

T-VASIS T visual approach slope indicator system *

. . .

VNAV Vertical navigation*

. . .

* Applicable as of 23 November 2028

Insert new text as follows:

Chapter 10

OBSTACLE EVALUATION AND CONTROL

(Applicable as of 23 November 2028)

Origin: OLSTF 24 ADOP/4	*Rationale* The amendments proposed in Annex 14, Volume I related to obstacle limitation surfaces is a radical change from the existing provisions and is a complete rewrite of Chapter 4. In order to adapt and apply the new surfaces defined in Annex 14, Volume I, to the type of operations, additional provisions of operational nature is required to help States or aerodrome operators. Hence this additional chapter in PANS-Aerodromes has been drafted to further explain the provisions in Annex 14, Volume I. The necessary provisions to support the application of these surfaces (OFS and OES) and processes involved in adjusting them when required has been elaborated. In addition, objects penetrating the OFS and OES may adversely impact flight operations. The impact of these penetrations to safety and regularity of aircraft operations must be examined through the conduct of an aeronautical study. However, there is no guidance available for the conduct of such aeronautical studies specific to OLS matters. Hence, the new chapter also includes detailed provisions related to aeronautical study. Further guidance will be provided in *Airport Services Manual*, (Doc 9137), Part 6 — *Control of Obstacles*.

10.1 GENERAL

10.1.1 The airspace around aerodromes is critical to the safety and regularity of operations. These areas are often congested with aircraft that are performing landing and take-off operations. It is critical that this area be maintained free from obstacles that could adversely impact the safety and accessibility of intended aircraft operations at aerodromes. To meet this purpose, sets of obstacle limitation surfaces (OLS) were established to be introduced at aerodromes to prevent the aerodromes from being unusable due to uncontrolled growth of obstacle around aerodrome.

10.1.2 A new obstacle or the extension of an existing obstacle can adversely affect the safety and regularity of aircraft operations; it may result in increased operating minima, changes in ANSP procedures, reduced capacity or operational restrictions on departures. It is therefore necessary to introduce OLS at and in the vicinity of aerodromes to effectively control the growth of obstacles and the possible turbulences they may be generated by these obstacles.

10.1.3 The existence of construction activities, buildings, structures, facilities, plantations, landfills or activities of any nature that interfere with the OLS may impose limitations on the effective utilization of an aerodrome or a portion of the airspace. It is therefore important for coordination to exist between civil aviation authorities and aerodrome operators in managing the OLS.

10.1.4 The OLS defines the limits to which objects may project into the airspace and imposes restrictions on any public or private property, making them an effective method in controlling land use in the vicinity of aerodromes.

10.1.5 The OLS comprises two sets of surfaces: obstacle free surfaces (OFS) and obstacle evaluation surfaces (OES). The OFS and OES have distinct purposes and are applied based on the type of runway, aeroplane design group (ADG) and the flight procedures available for that runway.

10.1.6 The objectives and operational practices described in this chapter are intended to provide the information needed to apply the surfaces defined in Annex 14 – *Aerodromes,* Volume I – *Aerodrome Design and Operations*.

The Surfaces

10.1.7 The OFS are surfaces that are applied within a defined airspace in the immediate vicinity of the aerodrome. The OFS are established to protect the existing and future operational capacity of the aerodrome by limiting obstacles. The OFS are intended to preserve accessibility of the aerodrome by containing standard operations (straight-in approaches) with a high level of probability. As such, they are to be kept free from obstacles except for existing obstacles and/or terrain which would have been assessed earlier.

10.1.8 The OES are surfaces that are applied in a defined airspace, in addition to the OFS, to be evaluated against obstacles. They act as triggering surfaces used in determining the acceptability of obstacles in ensuring safety and regularity of operations at the aerodrome. The penetration of the OES by terrain or obstacles are to be evaluated as they may adversely affect the safety or accessibility of the intended aircraft operations.

10.1.9 The dimensions of OFS and OES are determined based on aeroplane design group (ADG) categorization. The ADG utilizes two criteria, which are related to the aeroplane performance characteristics and dimensions. The first criterion is based on the aircraft's indicated airspeed at threshold and the second criterion on the aeroplane wingspan.

10.1.10 In addition to existing operations, the OFS and OES selected for the aerodrome should safeguard future planned aircraft operations.

Aeronautical study

10.1.11 Objects penetrating the OFS and OES may adversely impact flight operations. The impact of these penetrations to safety and regularity of aircraft operations must be examined through the conduct of an aeronautical study.

10.1.12 An aeronautical study is a process of examining an aeronautical concern by assessing its impact on safety and regularity of aircraft operations and identifying, if need be, possible mitigation measures.

10.1.13 An aeronautical study may also be applied to examine the impact of obstacles at and in the vicinity of new airports at the master planning stage.

Note.— Further guidance on master planning can be found in the Airport Planning Manual, *Part I –* Master Planning *(Doc 9184).*

10.1.14 In addition to flight operations, the aeronautical study must consider and address other aeronautical concerns such as impact on communication facilities, navigational aids, aerodrome operations and air traffic control line of sight.

10.2 OBJECTIVES

10.2.1 States shall define the roles and responsibilities of stakeholder(s) and delegate them the appropriate authority in the identification of the OFS and required OES, the safeguarding of these surfaces, and the surveillance of the areas within these surfaces.

Note.— Stakeholder(s) include the aerodrome operator, local authority, ANSPs, land use agency, military organization or any agency the State deems appropriate.

10.2.2 States shall establish a process for the identification of OFS and OES required to protect flight operations at an aerodrome.

10.2.3 Through the process, States or the appropriate authority shall:

a) determine the OFS and OES applicable based on ADG category;

b) vary the OFS, when required, to account for changes in the approach angle and the gradient of the take-off climb surface to account for local conditions and aeroplane characteristics;

c) determine the OES required to protect the operations at the aerodrome;

d) vary the OES based on the operational requirements of the aerodrome;

e) ensure the safeguarding of the OFS and OES; and

f) collect and disseminate obstacles and terrain data that have penetrated the OFS and OES.

Note.— The data collected are to be in accordance with terrain and obstacle datasets (TOD) provisions as stipulated in Annex 15 — Aeronautical Information Services *and the* Procedures for Air Navigation Services—Aeronautical Information Management *(PANS-AIM, Doc 10066).*

10.2.4 When instrument approaches are carried out on non-instrument runway(s), States or the appropriate authority shall review the dimensions of the approach and transitional OFS for such runway(s).

10.2.5 States shall establish a process for conducting aeronautical study.

10.2.6 States shall define the party/parties responsible for conducting the aeronautical study.

10.2.7 The process to be established by States shall include the following details:

a) identify stakeholders involved in the aeronautical study process;

b) define situations where an aeronautical study is triggered;

c) define the data required to produce a complete description of the aerodrome, obstacle and its environment;

d) describe the methodology for the conduct of the impact assessment;

e) identify appropriate mitigation measures to address any impact posed by an obstacle; and

f) define the acceptance criteria taking into consideration all studies and assessments submitted prior to approving the proposed obstacle.

Note.— An aeronautical study may be conducted anytime when, in the opinion of the State or appropriate authority, a proposed obstacle may adversely affect aircraft operations.

10.3 OPERATIONAL PRACTICES

10.3.1 Preventing the growth of obstacles

10.3.1.1 The primary responsibility to ensuring the aerodrome and its environment is and remains free from obstacles should be shared between the State and the aerodrome operator. The responsibilities and interactions among other additional stakeholders such as the aircraft operator, ANSP, local authority, etc. should be established and coordinated by the appropriate authority.

10.3.1.2 States are responsible for establishing a process for the selection of OLS required to protect the airspace against growth of obstacles and to act as triggers for evaluation of existing and potential obstacles and terrain. The process should include guidance on:

a) identifying the OLS needed to support the existing and/or planned operations at the aerodrome;

Note. — For OLS selection, refer to 10.3.1.5.

b) establishing the mechanisms to protect the surfaces and empower the appropriate authority to deny objects that may impact the safety and regularity of operations; and

c) using OFS and OES as trigger surfaces for survey of the aerodrome and its surroundings and the collection of obstacle data.

10.3.1.3 The ADG consists of two criteria, indicated air speed at threshold and wingspan. In choosing the applicable ADG, the appropriate authority should consider the critical aeroplane operating at the aerodrome based on these two criteria. The aeroplane design group shall be determined by selecting the aeroplane design group corresponding to the highest values of indicated airspeed at threshold and wingspan of the aeroplanes for which the runway is intended.

Aeroplane design group	**Indicated airspeed at threshold**		**Wingspan**
I	Less than 169 km/h (91 kt)	and	Up to but not including 24 m
IIA	Less than 169 km/h (91 kt)	and	24 m up to but not including 36 m
IIB	169 km/h (91 kt) up to but not including 224 km/h (121 kt)	and	Up to but not including 36 m
IIC	224 km/h (121 kt) up to but not including 307 km/h (166 kt)	and	Up to but not including 36 m
III	Less than 307 km/h (166 kt)	and	36 m up to but not including 52 m
IV	Less than 307 km/h (166 kt)	and	52 m up to but not including 65 m
V	Less than 307 km/h (166 kt)	and	65 m up to but not including 80 m

10.3.1.4 In aerodromes with more than one runway, the appropriate authority can define different ADG for each runway and in areas where the surfaces overlap, the more stringent surface will apply.

Note.— Guidance on the application of ADG can be found in the Airport Services Manual, *Part 6 –* Control of Obstacles *(Doc 9137).*

10.3.1.5 The OLS to be adopted are dependent on:

a) the type of runway – precision, non-precision and non-instrument;

b) the ADG applicable for the runway; and

c) existing and/or planned flight operations at an aerodrome and the corresponding OES(s) needed to protect the flight procedures. When selecting OES, the appropriate authority can adopt the OES defined in Annex 14, Volume I, Chapter 4, or design OES specific to the procedures conducted at the aerodrome.

10.3.1.6 States may delegate the responsibility for the safeguarding and surveying of areas within these surfaces to other appropriate authority.

10.3.1.7 The protection of these surfaces can be enhanced by incorporating them into the zoning laws. In lieu of zoning laws, authority may also consider having the necessary coordination process with the land use agencies to ensure aviation requirements are factored into land use planning and airport master planning. The aviation requirements are not limited to OLS only but may include other requirements relating to disturbance to communications, navigation, and surveillance (CNS) facilities, glare or glint issues, wildlife management considerations and other potential hazards.

Note.— Further guidance can be found in the Airport Services Manual, *Part 6 –* Control of Obstacles *(Doc 9137).*

10.3.1.8 The surveying of aerodromes and their vicinity is key to ensuring safety of flight operations. The establishment of OFS and OES help in ensuring the obstacle database remains updated as these surfaces act as additional triggers. Objects that penetrate these surfaces are to be assessed and their information captured in the database.

10.3.1.9 A process should be established to share the obstacle data with AIS. These data should be published in Aeronautical Information Management (AIM) databases as part of TOD, which will eventually be made available to airlines, pilots, charting companies and other ANSPs. The same data will be used to derive aeronautical charts such as the electronic Aerodrome Terrain and Obstacle Chart.

10.3.1.10 The data collected, specifically the geographical coordinates of obstacles in TOD Area 2 and Area 3, should be measured and reported in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation, obstacle type, marking and lighting (if any) of obstacles should be reported.

Note.— The TOD requirements including specifications on data quality can be found in Annex 15 and PANS-AIM, (Doc 10066), Table A1-6.

10.3.2 Adapting OFS and OES to operational needs

Adjusting obstacle free surfaces

10.3.2.1 The OFS are designed based on the nominal approach angle of 3.0°. There are aerodromes where the approach angle can either be lower or higher.

10.3.2.2 The slope of the approach surface is intended to adapt to approach operations that have an approach angle of 3.0° or higher. The slope of the approach surface may be raised if approach procedures with an approach angle of more than 3.0° are implemented. However, the approach angle should not be increased to enable the growth of obstacles.

10.3.2.3 Where the approach angle is less than 3.0° the slope of the approach surface must be lowered to protect the operations.

10.3.2.4 In certain circumstances, due to alignment of visual slope indicator systems with instrument landings aids, the slope of the approach surface must be lowered, too, to align the surface with the requirements of the *Procedures for Air Navigation Services — Aircraft Operations* (Doc 8168).

10.3.2.5 The slope of the take-off climb surface can be reviewed if the local conditions and the operational characteristics of aeroplanes operating at the runway support a slope higher than 2 per cent. Such review should be done in consultation with the aircraft operator as any increase to the slope may impact take-off performances and reduces payload.

Adjustments of the Approach OFS

10.3.2.6 The approach OFS has been designed based on the approach angle of 3.0° and runway type. Any changes to these parameters will require changes to the dimensions of the OFS.

10.3.2.7 Changes to the approach angle will affect the slope and length of the approach OFS. As the OFS for instrument runway is designed to reach a height of 150 m (500 ft) or up to the obstacle clearance altitude/height (OCA/H), an increase or decrease in the slope will change the length of the surface.

Note.— Further guidance on changing the slope of OFS is given in the Airport Services Manual, *Part 6* – Control of Obstacles *(Doc 9137).*

10.3.2.8 The slope of the approach OFS is associated with:

a) the visual segment surface (see PANS-OPS (Doc 8168), Volume II, Part I, Section 4, Chapter 5, paragraph 5.4.6.2) which protects the visual phase of an instrument approach procedures; and

b) the obstacle protection surface of a PAPI for both instrument and non-instrument approach procedures.

10.3.2.9 To calculate the slope when there are changes to the approach angle, the following steps should be taken:

a) for runways served with instrument approaches:

   i) subtract 1.12° from the approach angle. e.g. For approach angle of 3.5° the visual segment surface is 2.38° or 4.1 per cent;

   ii) identify the slope associated with the obstacle protection surface. e.g. The harmonization between a 3.0° ILS and the PAPI will result in the obstacle protection surface of the PAPI to be at 3.22 per cent to align with the signal of the ILS. (see Annex 14, Volume 1, Chapter 5,

Figure 5-21 and Table 5-3). The slope of the approach surface shall be reduced accordingly; and

iii) the lower slope between the two calculated in (i) and (ii) will be adopted for the approach OFS;

b) for runways intended for visual approach operations only:

i) when T visual approach slope indicator system (T-VASIS), abbreviated T visual approach slope indicator system (AT-VASIS), PAPI and APAPI are provided, the obstacle protection surface will be used to determine the slope.

10.3.2.10 The length of the approach OFS is calculated to ensure the surface reaches a height of 150 m (500 ft.). e.g. For approach OFS slope of 4.1 per cent, the length is 500 ft/0.041 = 12 195 ft or 3.7 km. For instrument approaches, the length may need to be extended to reach the applicable OCA/H.

10.3.2.11 Where the final approach track is offset and intersects the extended runway centre line, the splay on the side closest to the final approach track should be increased by the offset angle. Where the final approach track is offset but does not intersect the extended runway centre line, the splay closest to the final approach track should be increased by an amount equal to the final approach course offset at 1 400 m from the runway threshold.

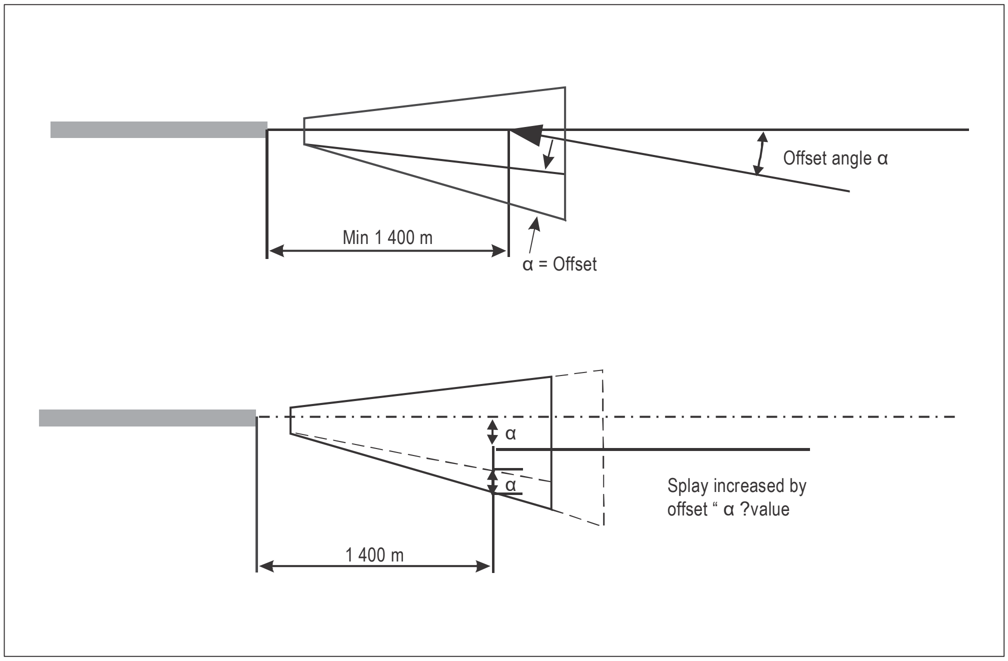


Figure 10-1. Plan view visual segment surface offset final approach with runway centre line crossing

Adjustment of the inner approach OFS

10.3.2.12 The inner approach OFS is part of the approach OFS. The surface will have the same slope as the approach OFS. Any adjustment to the slope of the approach OFS will bring about a corresponding change in the slope of the inner approach OFS. As the length of the inner approach extends to a height of

45 m, any variation to the slope will require adjustment to the length. The length of the inner approach can be calculated using the following formula:

Length of inner approach = 45 m/slope. For example, an aerodrome with inner approach slope of 3.33 per cent, the required length is: 45 m/0.0333=1 350 m.

Runway holding position and penetration of the approach OFS

10.3.2.13 The runway holding position can be established at the runway end or at the location prior to the landing threshold to reduce runway occupancy and increase runway capacity. This position is in accordance with the dimension stated in Table 3-2 of Annex 14 – *Aerodromes*, Volume 1 – *Aerodrome Design and Operations*. Under such situations, aircraft holding at the runway holding position may penetrate the approach OFS. In any case, the following surfaces should not be penetrated:

a) inner approach, inner transitional and balked landing surfaces (OFS):

the inner approach, inner transitional and balked landing surfaces establish a minimum volume of airspace for the protection of aeroplanes during balked landings and late go-arounds against fixed and mobile objects and

b) obstacle clearance surface:

the OCS are introduced in PANS-OPS (Doc 8168) to deal with penetrations of the visual segment surface (VSS). Obstacles shall not require the pilot to destabilize the approach to avoid them. For this purpose, no obstacle shall penetrate an obstacle clearance surface (OCS).

Adjustment of the take-off climb surface (OFS)

10.3.2.14 Aircraft taking off may have different climb performances and therefore would be variably affected by an obstacle. During take-off, aircraft do not all lift off the runway from the same point nor do they follow the same climb rates. Hence, an object may be an obstacle for an aircraft with low performances on take-off but not to another aircraft with better performances.

10.3.2.15 A balanced approach to the selection of the gradient for the take-off climb surface is recommended. Local considerations need to be accounted for, as well as aircraft operator's requirements for efficient operations.

10.3.2.16 For typical aircraft operations with take-off masses not at maximum, the slope of the take-off climb surface may be increased to match the slope of the approach OFS in the opposite runway direction when no significant limitations are to be expected, e.g. for narrow-body aircraft at low elevation aerodromes with longer runways.

10.3.2.17 In contrast, some aerodromes at higher elevations and/or in hot environments may require a slope of the take-off climb surface of less than 2.0 per cent.

Adjusting obstacle evaluation surfaces

10.3.2.18 States or the appropriate authority should identify one or more OES to protect the operations at the aerodrome. The OES selected should reflect the type of operations conducted/planned at the aerodrome. In selecting the OES, the appropriate authority should consider both existing and planned operations.

10.3.2.19 The appropriate authority can either:

a) modify the OES to suit the operational needs of the aerodrome;

b) declare an OES as an obstacle free surface; or

c) design an OES specific to the flight procedures conducted at the aerodrome.

Modifying horizontal OES

10.3.2.20 In situations where there is no circling, there is no need to establish the entire extent of horizontal OES. When a circling approach is not allowed on one side of the runway, the extent of horizontal OES may be reduced in order not to limit new constructions in that area.

10.3.2.21 Often, circling minima are not at the minimum due to the terrain and obstacle environment. In such cases, the height of the horizontal OES may be raised to match the obstacle clearance altitude (OCA) of the circling approach, considering the applicable minimum obstacle clearance requirements.

Note 1.— A single or a combination of horizontal OES is to be adopted at aerodromes where there are circling operations.

Note.2.— It must be ensured that the modification of the horizontal OES will not impact the safety of visual procedures and aerodrome circuits, nor significantly affect the regularity of other flight procedures including instrument approach and departures procedures.

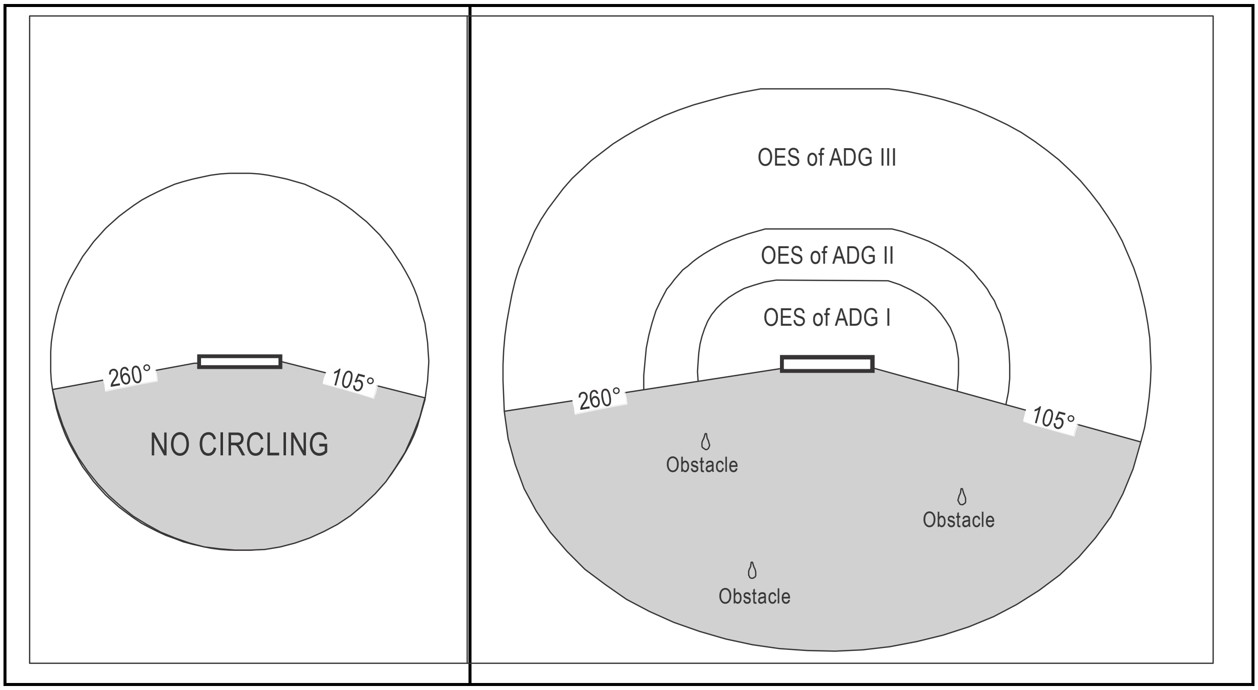


Figure 10-2. Modifying horizontal OES on a non-circling area

Declaring an OES as a surface that is free of obstacles

10.3.2.22 States or the appropriate authority may decide to declare an OES as a surface that should be free of obstacles. This may be done to protect the airspace in the vicinity of the aerodrome by restricting growth of obstacles that may undermine future aerodrome needs and flight operations. By not allowing penetration of the OES, it would simplify the process for approving obstacles, reducing the number of aeronautical studies required and reduce the likelihood of the flight procedures being amended.

10.3.2.23 When declaring an OES as a surface that should be maintained free of obstacles, amendments are necessary to the local zoning laws, aerodrome standards, etc.

Specific obstacle evaluation surfaces

10.3.2.24 In cases where existing and/or planned flight procedures cannot be safeguarded by the OES specified in Annex 14, Volume 1, Chapter 4, specific OES should be established to account for the local flight procedures.

10.3.2.25 Adjustments of the OES or specific OES may be required for, including but not limited to:

a) instrument approach procedures based on NDB or radar;

b) straight-in instrument approach procedures with low approach minima (OCA/H);

c) offset instrument approach procedures, or

d) curved instrument approach procedures (RNP AR).

10.3.2.26 While the Annex 14, Volume I, horizontal surface(s) and surface for straight-in instrument approaches consider most common straight-in instrument approaches, the variety of all possible instrument approaches procedures cannot be addressed.

10.3.2.27 Precision approaches as well as straight-in approaches with significant offsets or curved approaches are not considered for the design of the surface for straight-in instrument approaches. Furthermore, low approach minima may not be fully addressed.

10.3.2.28 For non-precision approaches, approach minima of as low as 120 m (400 ft) may be achieved. With a minimum obstacle clearance (MOC) of 75 m (250 ft) for the final approach, an obstacle as high as OES in the inner section (45 m or 150 ft) would result in approach minima of 120 m (400 ft). An obstacle as high as the OES in the outer section (60 m or 200 ft) would result in approach minima of 135 m (450 ft). An obstacle beyond the limits of the surfaces as high as 100 m (330 ft) would result in approach minima of 175m (580ft). In case the non-precision approach procedure supports step-down fixes (SDF), the approach minima of 175 m (580 ft) may be lowered to 135 m (450 ft) and to 120 m (400 ft).

10.3.2.29 For required navigation performance (RNP) approach procedures with lateral navigation (LNAV)/vertical navigation (VNAV) minima or LPV minima (satellite-based augmentation system (SBAS) approach procedure with vertical guidance (APV)-I), approach minima of approximately 85 m to 95 m (280 ft to 310 ft) (depending on the aircraft speed category) or 100 m to 110 m (330 ft to 360 ft) may be achieved, depending on the actual approach procedure design as well as altitude and temperature effects, assuming obstacles as high as the surface for non-precision approaches.

10.3.2.30 Low approach minima are considered by means of the Annex 14, Volume I surface for precision approaches. This surface, however, is based on the basic ILS surfaces are therefore considered precision approaches (using ILS, microwave landing system (MLS), GBAS, SBAS CAT I) only. For non-precision approach procedures (NPA) and APV with low approach minima (OCA/H), the dimensions of the Annex 14 surface for precision approaches is not sufficient and greater areas need to be considered.

10.3.2.31 The design of specific OES may be aligned with the protection areas specified for the design of instrument flight procedures. The related criteria are contained in PANS-OPS (Doc 8168) and the *Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual* (Doc 9905).

10.3.2.32 Furthermore, specific OES may be established to account for the local visual flight operations, including specified visual circuit patterns, VFR routes as well as VFR reporting points.

Note.— Guidance material for the protection of visual flight operations is contained in the Airport Services Manual, *Part 6 –* Control of Obstacles *(Doc 9137).*

10.3.3 Evaluating hazardous objects

10.3.3.1 Objects located beyond or below the OFS and OES may still be a concern to the safety and regularity of flight operations. These objects, due to their characteristics and purpose, may pose a hazard to air navigation. Such objects include wind turbines, chimneys, skeleton structures, transmission lines and power stations.

10.3.3.2 The orientation of buildings and their façades are known to cause turbulence, glare and disturbance to CNS equipment. The appropriate authority should work with land planning agencies to manage these hazards for buildings that are in the immediate vicinity of the aerodrome.

10.3.3.3 An aeronautical study should be considered when examining the impact on safety and regularity of flight operations due to these developments.

Note.— Details on the impact and references on possible assessment techniques to evaluate the risks posed by these objects can be found in the Airport Services Manual, *Part 6 –* Control of Obstacles *(Doc 9137).*

Appendix to Chapter 10

AERONAUTICAL STUDY PROCESS

1. Aeronautical study

1.1 To investigate an aeronautical concern arising from the introduction of an obstacle, an aeronautical study is used to evaluate the impact of the obstacle on flight operations and identify possible measures that can mitigate these concerns.

1.2 The process of conducting an aeronautical study should include:

a) data gathering;

b) stakeholder engagement and impact assessment;

c) identifying mitigations (if applicable); and

d) acceptance or rejection.

Note.— A flowchart showing the aeronautical study process is included as an Attachment to this Appendix.

2. Data gathering

2.1 Information collected should include but not be limited to:

a) national regulations and procedures (zoning laws, land use policy);

b) use of the aerodrome (day/night, IFR/VFR, public/private use, certified/uncertified);

c) dimensions of approach lighting system;

d) existing and future runway and taxiway characteristics;

e) mix of aircraft operating at the aerodrome;

f) number of regular flights (commercial air transport);

g) procedures specific to the aerodrome;

h) flight procedures (existing and future);

i) contingency procedures;

j) details on existing obstacles and mitigations;

k) existing/planned visual navigation aids/electronic navigation aids/surveillance aids/communication aids etc.; and

l) airspace structure and details of nearby aerodromes.

Note.— For non-flight operations related aeronautical studies, other information may be required.

2.2 Details of the proposed obstacle or terrain should include but are not limited to:

a) location;

b) obstacle evaluation;

c) classification (e.g., building, crane, tree(s), antenna(s), power lines);

d) dimensions as well as height, top elevation including ground elevation;

e) frangibility;

f) permanence (permanent/temporary);

g) presence (fixed/mobile);

h) visibility (e.g., marking and lighting); and

i) material (as it may interfere with electronic signals).

2.3 Aerodrome details (this list is not exhaustive and may include others):

a) ICAO code;

b) CNS facilities;

c) procedures specific to the aerodrome;

d) use of aerodrome (IFR/VFR day/low visibility operations)

e) visual aids;

f) type of aircraft;

g) runway characteristics (number of runways, dimensions, type);

h) airspace;

i) nearby aerodromes; and

j) aerodrome noise zones.

2.4 Affected surfaces:

a) surfaces penetrated; and

b) extent of penetration.

2.5 Flight operations related to instrument flight procedures (this list is not exhaustive and may include others):

a) instrument approach procedures (initial, intermediate, final and missed approaches as well as visual segment and circling);

b) SIDs (standard instrument departure routes and/or omni-directional departures);

c) standard arrival routes (STAR);

d) minimum sector altitudes (MSA) and terminal arrival altitudes (TAA);

e) holding patterns;

f) ATC surveillance minimum altitudes; and

g) en route ATS routes.

2.6 Flight operations (visual flight procedures and visual approaches):

a) visual departures;

b) traffic patterns (standard circuit patterns or other published patterns, incl. patterns for entry and exit to/from circuit patterns); and

c) VFR routes and VFR reporting points.

3. Stakeholder engagement and impact assessment

3.1 The proponent of the aeronautical study can either be an agency of the State, aerodrome operators or by any appropriate authority. In conducting the study, it is critical to have the participation of all relevant stakeholders. The stakeholders should include but are not limited to:

a) the civil aviation authority;

b) proponent of the proposed construction/development;

c) the aerodrome operator;

d) air navigation services providers;

e) flight procedure designers;

f) aircraft operators (commercial aviation and the military); and

g) other appropriate authorities (e.g. land use planner, military etc.).

Note 1. — The level of stakeholders' involvement may vary depending on the needs of the study.

Note 2. — The design of procedures in accordance with PANS-OPS (Doc 8168) criteria assumes normal operations. It is the responsibility of the operator to provide contingency procedures for abnormal and emergency operations. It might be necessary to involve aircraft operators in the aeronautical study process.

3.2 There could be a situation where more than one OES is penetrated. Due to different purposes each OES serves, every surface needs to be evaluated individually to assess its impact.

Note.— Explanations on how impact assessments are conducted can be found in the Airport Services Manual, *Part 6* – Control of Obstacles *(Doc 9137).*

4. Identifying mitigations

Note.— Identifying the mitigating measure and assessing their impact on stakeholders is a key task in the aeronautical study process. Different measures are required to address OFS and OES penetrations. Certain mitigation measures, while acceptable, may not be desirable due to the penalty it imposes on aerodrome operations.

4.1 The mitigation measure identified should consider the OLS that is/are being penetrated.

4.2 Obstacles penetrating the OFS will impose an adverse effect on the safety of flight operations and should be removed. Where removal is not practicable, the penetrations are to be mitigated by means of limiting operations at the aerodrome such as designating the runway for departure only or allowing only visual approaches to the runway, before considering other measures. Other measures include, but are not limited to:

a) displacing the threshold; and/or

b) raising the glide slope and PAPI angle.

4.3 Obstacles penetrating the OES may have an adverse impact to the safety or accessibility of intended aircraft operations. Mitigation measures may include, but are not limited to:

a) adjusting flight procedures (e.g., increased minimum obstacle clearance altitudes, increased minimum climb gradients, change of routing);

b) including the obstacles in the relevant ICAO charts;

c) promulgating safety information to the users of the aerodrome (particularly concerning the change);

d) increasing approach minima (OCA/H);

e) increasing minimum obstacle clearance altitudes;

f) increasing minimum climb gradient for departures (PDG, procedure design gradient);

g) increasing descent gradients;

h) increasing flight altitude;

i) revising traffic/circuit patterns;

j) revising VFR routes and/or reporting points; and

k) adjusting/including marking and lighting.

4.4 Upon completion of the aeronautical study, it may be necessary to conduct a safety risk assessment to quantify the risk probability and severity and the acceptability of any proposed mitigation measures in reducing the risk to an acceptable level.

Note. — Provisions on safety risk assessment are stipulated in Chapter 3 of this document and on the Safety Management Manual (Doc 9859).

5. Acceptance

5.1 The study may result in one of the following outcomes where the obstacle is:

a) acceptable, because the risk is already mitigated;

b) acceptable, only if the risk is mitigated; or

c) not acceptable, because the risk cannot be mitigated.

5.2 The State or the appropriate authority establishes the approval/acceptance criteria to be used in evaluating the study. The study is to be submitted by the aerodrome operator or an appropriate authority prior to development or installation of the proposed obstacle.

5.3 The State or the appropriate authority should analyse the aeronautical study and verify that:

a) appropriate coordination has been performed between the stakeholders;

b) aeronautical concerns have been properly investigated and assessed, based on current and future flight operations and procedures;

c) proposed mitigation measures adequately address the impact posed by the obstacle; and

d) the subsequent safety risk assessment, when required, has been conducted in accordance with Chapter 3 of this document and meets the acceptability criteria specified in 3.5.1.

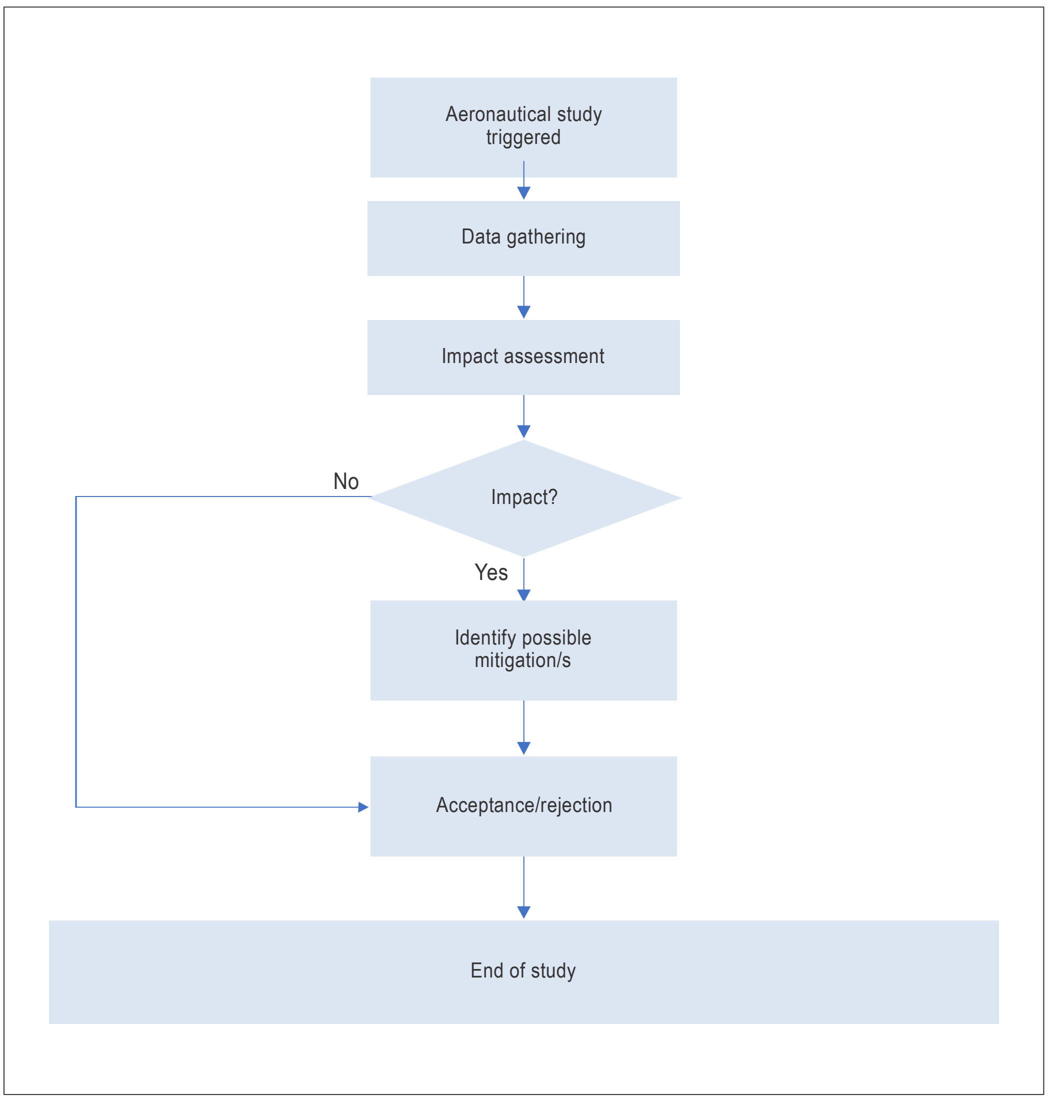
Note. — It is preferable to have relevant experts from the State, as required, on the team that conducts the aeronautical study. On completion of the analysis of the aeronautical study, the State or the appropriate authority:

a) gives formal approval or acceptance of the aeronautical study to the aerodrome operator or an appropriate authority. If in the study some impacts to flight operations have been underestimated or have not been identified, coordinate with the aerodrome operator or an appropriate authority to reach an agreement on safety acceptance; or

b) if no agreement can be reached, rejects the proposal for possible resubmission by the aerodrome operator or an appropriate authority; or

c) may choose to impose conditional measures to ensure safety and regularity.

Attachment to Chapter 10
Aeronautical study flowchart



End of new text.

INITIAL PROPOSAL 2
Improved operational safety through enhanced visual aids to denote construction works at aerodromes

Chapter 4

WORK IN PROGRESS (WIP)

. . .

4.3 OPERATIONAL PRACTICES

. . .

Origin	*Rationale*
ADOP/4	The objective of these proposals is to specify operational procedures related to the use of visual aids for denoting restricted areas of use to be applied by aerodrome operators to ensure aerodrome operational safety described in Annex 14, Volume I, Chapter 7. Such procedures include the use of appropriate visual aids in risk mitigation, conduct of safety risk assessment; types of power supplies, inspection regime and alerting system

4.3.3 A safety risk assessment of all planned works should be completed beforehand in order to ensure the ~~risks~~ hazards to the safe operation of aircraft have been identified by the aerodrome operator in coordination with interested parties, and appropriate mitigation measures introduced to keep risks to an acceptable level. Risk mitigation actions include, inter alia, the use of visual aids to denote restricted use area.

. . .

4.3.8 The following actions should be taken when establishing the worksite, as well as throughout the duration of works, when necessary:

a) a safety risk assessment should be conducted to determine the need for visual aids to indicate temporary changes to the movement area;

~~a~~b) unserviceability markers are displayed when any portion of a taxiway, apron, or holding bay is unfit for the movement of aircraft, but it is still possible for aircraft to bypass the area safely;

~~b~~c) existing markings leading into a worksite should be masked or the route closed;

Editorial Note.— Renumber subsequent paragraphs as needed.

. . .

Note 1.— Unserviceability relates to areas temporarily not available for operational use.

. . .

Note 5.— Temporary changes to the movement area may include, inter alia, reduction in the runway length, reduction in the maximum allowable wingspan, taxiway closure or any other closure to the movement area. Certain visual aids such as closed runway lighting could be used for a temporary period *varying from a few hours to several weeks or longer, depending on the works in progress or other closure reasons.*

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RESPONSE FORM TO BE COMPLETED AND RETURNED TO ICAO TOGETHER WITH ANY COMMENTS YOU MAY HAVE ON THE PROPOSED AMENDMENTS

To: The Secretary General
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Quebec
Canada, H3C 5H7

(State) ____

Please make a checkmark (✓) against one option for each amendment. If you choose options "agreement with comments" or "disagreement with comments", **please provide your comments on separate sheets**.

	Agreement without comments	*Agreement with comments**	*Disagreement without comments*	*Disagreement with comments*	*No position*
Amendment to Annex 14, Volume I (Attachment B refers)					
Amendment to PANS-Aerodromes (Doc 9981) (Attachment C refers)					

*"Agreement with comments" indicates that your State or organization agrees with the intent and overall thrust of the amendment proposal; the comments themselves may include, as necessary, your reservations concerning certain parts of the proposal and/or offer an alternative proposal in this regard.

Signature: ______________________________ Date: ___________________________________

— END —