CIVIL AVIATION GUIDANCE MATERIAL – 1412

GUIDELINES FOR OBSTACLE MANAGEMENT

CIVIL AVIATION AUTHORITY OF MALAYSIA

ISSUE 01
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Introduction

This Civil Aviation Guidance Material 1412 (CAGM 1412) is issued by the Civil Aviation Authority of Malaysia (CAAM) to provide guidance for the Obstacle Management, pursuant to Civil Aviation Directives 14 Vol. I – Aerodrome Design and Operations (CAD 14 Vol. I – Aerodrome Design and Operations).

Organisations may use these guidelines to ensure compliance with the respective provisions of the relevant CAD's issued. When the CAGMs issued by the CAAM are complied with, the related requirements of the CAD's may be deemed as being satisfied and further demonstration of compliance may not be required.

(Datuk Captain Chester Voo Chee Soon)
Chief Executive Officer
Civil Aviation Authority of Malaysia

Civil Aviation Guidance Material Components and Editorial practices

This Civil Aviation Guidance Material is made up of the following components and are defined as follows:

Standards: Usually preceded by words such as *"shall"* or *"must"*, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

Recommended Practices: Usually preceded by the words such as "*should"* or "*may*", are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

Appendices: Material grouped separately for convenience but forms part of the Standards and Recommended Practices stipulated by the CAAM.

Definitions: Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

Tables and Figures: These add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

Notes: Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

Attachments: Material supplementary to the Standards and Recommended Practices or included as a guide to their application.

It is to be noted that some Standards in this Civil Aviation Guidance Material incorporates, by reference, other specifications having the status of Recommended Practices. In such cases, the text of the Recommended Practice becomes part of the Standard.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Guidance Material, the use of the male gender should be understood to include male and female persons.

Record of Revisions

Revisions to this CAGM shall be made by authorised personnel only. After inserting the revision, enter the required data in the revision sheet below. The *'Initials'* has to be signed off by the personnel responsible for the change.

Rev No.	Revision Date	Revision Details	Initials

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Summary of Changes

ISS/REV no.	Item no.	Revision Details

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1 General

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

1.2 The criteria for controlling obstacles in this document are based on Obstacle Limitation Surfaces (OLS) as detailed in Civil Aviation Directive (CAD) 14 Vol I – Aerodrome Design and Operations.

1.3 This document is not exhaustive in addressing the control of obstacles, particularly the wider spectrum of the ICAO PANS-OPS surfaces and obstruction charts. There are several publications available, which address the control of obstacles, and the production of obstruction charts, in detail.

1.4 This document shall apply to existing and proposed man-made objects of permanent or temporary construction or alteration and apparatus of a permanent or temporary nature or any alteration thereto, objects of natural growth and terrain. The guidance shall apply to the use of navigable airspace by aircraft and to existing or proposed air navigation facilities, aerodromes, air traffic services routes including approach and departure routes to and from instrument and other runways.

2 Definitions

2.1 For the definitions of this guidance, refer to CAD 14 Vol. I – Aerodrome Design and Operations accordingly.

3 Obstacle Limitation Surfaces (OLS)

3.1 General

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

3.1.2 The surfaces established shall allow not only for existing operations, but also for the ultimate development envisaged for each aerodrome.

3.1.3 The OLS provided for the control of obstacles includes:

a) outer horizontal surface (OHS);

b) inner horizontal Surface (IHS);

c) conical surface (CS);

d) approach surface;

e) take-off climb surface;

f) transitional surfaces;

g) inner approach surface;

h) inner transitional surface; and

i) balked landing surface.

Figure 3-1. shows the obstacle limitation surfaces in the vicinity of aerodrome.

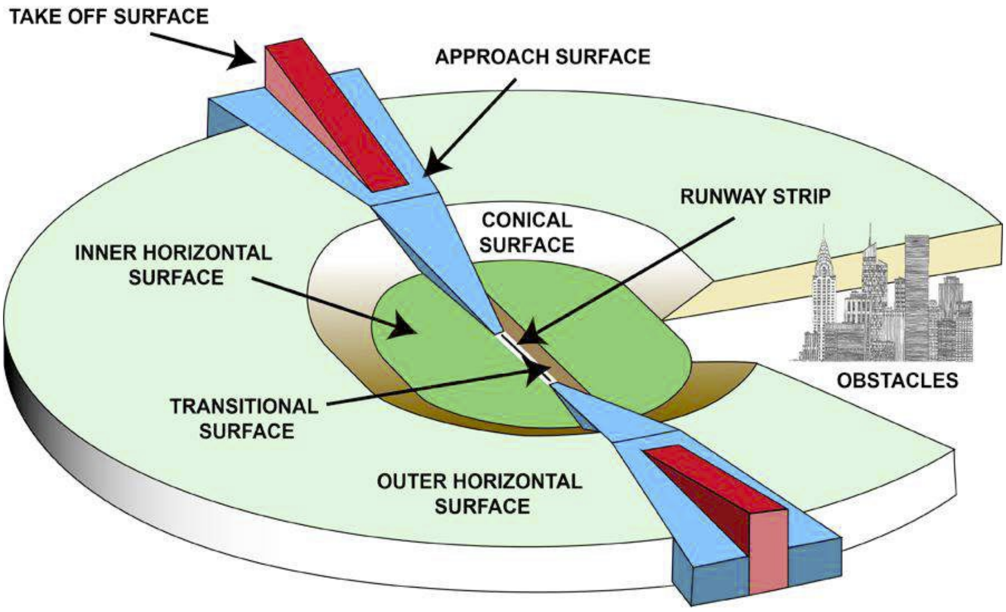

Figure 3-1. Obstacle limitation surfaces

3.1.4 Shown below is a list of publications, which can be referred to as applicable standards and practices and for further information and guidance:

a) CAD 14 Volume I – Aerodrome Design and Operations; and

b) CAD 4 - Aeronautical Charts.

3.2 Obstacle Limitation Surfaces (OLS) Requirement

3.2.1 The physical dimensions of the OLS surfaces, for approach runways, as determined using Table 3-1.

	RUNWAY CLASSIFICATION									
	Non-instrument				Non-precision approach			Precision approach category		
								I		II or III
	Code number				Code number			Code number		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 m	150 m	140 m	280 m	280 m	140 m	280 m	280 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	—	—	—	—	—	3 600 m[b]	3 600 m[b]	12 000 m	3 600 m[b]	3 600 m[b]
Slope	—	—	—	—	—	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	—	—	—	—	—	8 400 m[b]	8 400 m[b]	—	8 400 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%

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 4.2.9 or 4.2.17).
c. Distance to the end of strip.
d. Or end of runway whichever is less.
e. 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.

Note.— See Circulars 301 and 345, and Chapter 4 of the PANS-Aerodromes, Part I (Doc 9981) for further information.

Table 3-1. Dimensions and slopes of obstacle limitation surfaces — Approach runways

3.2.2 The physical dimensions of the OLS surfaces, for take-off runways, as determined using Table 3-2.

Surface and dimensions[a] (1)	Code number 1 (2)	2 (3)	3 or 4 (4)
TAKE-OFF CLIMB			
Length of inner edge	60 m	80 m	180 m
Distance from runway end[b]	30 m	60 m	60 m
Divergence (each side)	10%	10%	12.5%
Final width	380 m	580 m	1 200 m 1 800 m[c]
Length	1 600 m	2 500 m	15 000 m
Slope	5%	4%	2%[d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See 4.2.24 and 4.2.26.

Table 3-2. Dimensions and slopes of obstacle limitation surfaces - Runways Meant for Take-Off

3.2.3 Obstacle-Free Zone (OFZ)

a) An OFZ is intended to protect aeroplanes from fixed and mobile obstacles during precision approach operations when approaches are continued below decision height, and during any subsequent missed approach or balked landing with all engines operating normally. It is not intended to supplant the requirement of other surfaces or areas where these are more demanding.

b) The OFZ must be kept free from fixed objects, other than lightweight frangible mounted aids to air navigation which must be near the runway to perform their function, and from transient objects such as aircraft and vehicles when the runway is being used for precision approaches.

c) The OFZ is made up of the following obstacle limitation surfaces:

1) inner approach surface;
2) inner transitional surfaces; and
3) balked landing surface.

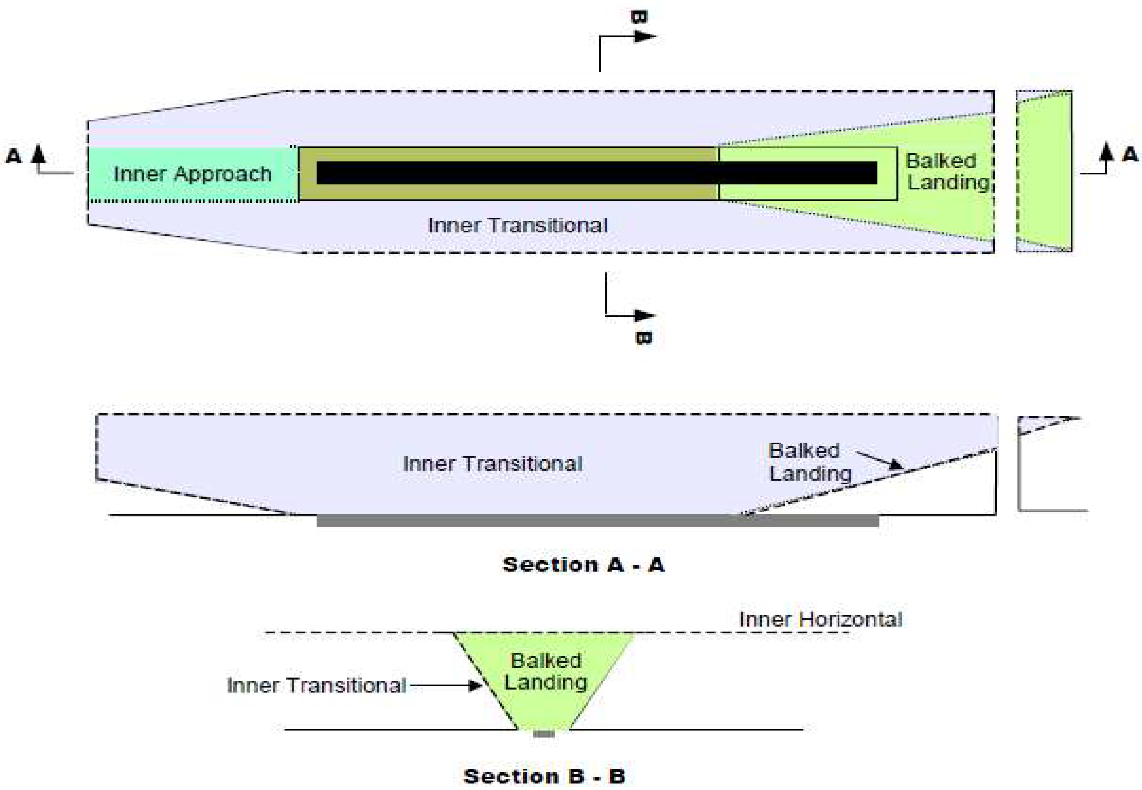

Figure 3-2: Inner approach, inner transitional and baulked landing obstacle limitation surfaces

4 Notification of Proposed to Construct a Building or Structure

4.1 Any development at or in the vicinity of an aerodrome including construction, establishment or erection of objects shall be notified to the CAAM for review and approval.

4.2 Any development in areas beyond the vicinity of an aerodrome, at least those objects which extend to a height of 150 m or more above ground level, including construction, establishment or erection of objects shall be notified to the CAAM for review and approval.

4.3 The obligation to notify of any proposed development, or part thereof, which may constitute or generate obstacles, should rest with the developer or the property owner.

4.4 Notification of development, establishment or erection of objects that may constitute as obstacles shall be made to the CAAM via Application Form CAAM/ASD/OLS/01 (Appendix I) and accompanied by the prescribed fee.

4.5 Where an obstacle is to be located on the aerodrome, the aerodrome operator is responsible for notifying such development.

4.6 CAAM may permit the proposed development under certain terms and conditions to ascertain continued safety of air navigation.

5 Infringement of the Obstacle Limitation Surfaces

5.1 The CAD 14 Vol. I (Chapter 4) states that if an obstacle infringe the Obstacle Limitation Surface (OLS) shall not be authorised except when, in the opinion of the CAAM, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

5.2 The applicant may submit an application to CAAM. The following should be included in the application:

a) a formal letter of application;

b) application Form CAAM/ASD/OLS/01 and accompanied by the prescribed fee; and

c) shielding and/or aeronautical studies.

6 Shielding Principles

Obstacles Penetrating the Approach and Take-Off Climb Surfaces

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

6.2 As illustrated in Figure 6-1, a new obstacle may be assessed as not imposing additional restrictions if:

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

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

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

Obstacles Penetrating the Inner and Outer Horizontal and Conical Surfaces

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

Obstacles Penetrating the Transitional Surfaces

6.4 A new obstacle may be assessed as not imposing additional restrictions if it does not exceed the height of an existing obstacle which is closer to the runway strip and the new obstacle is located perpendicularly behind the existing obstacle relative to the runway centre line.

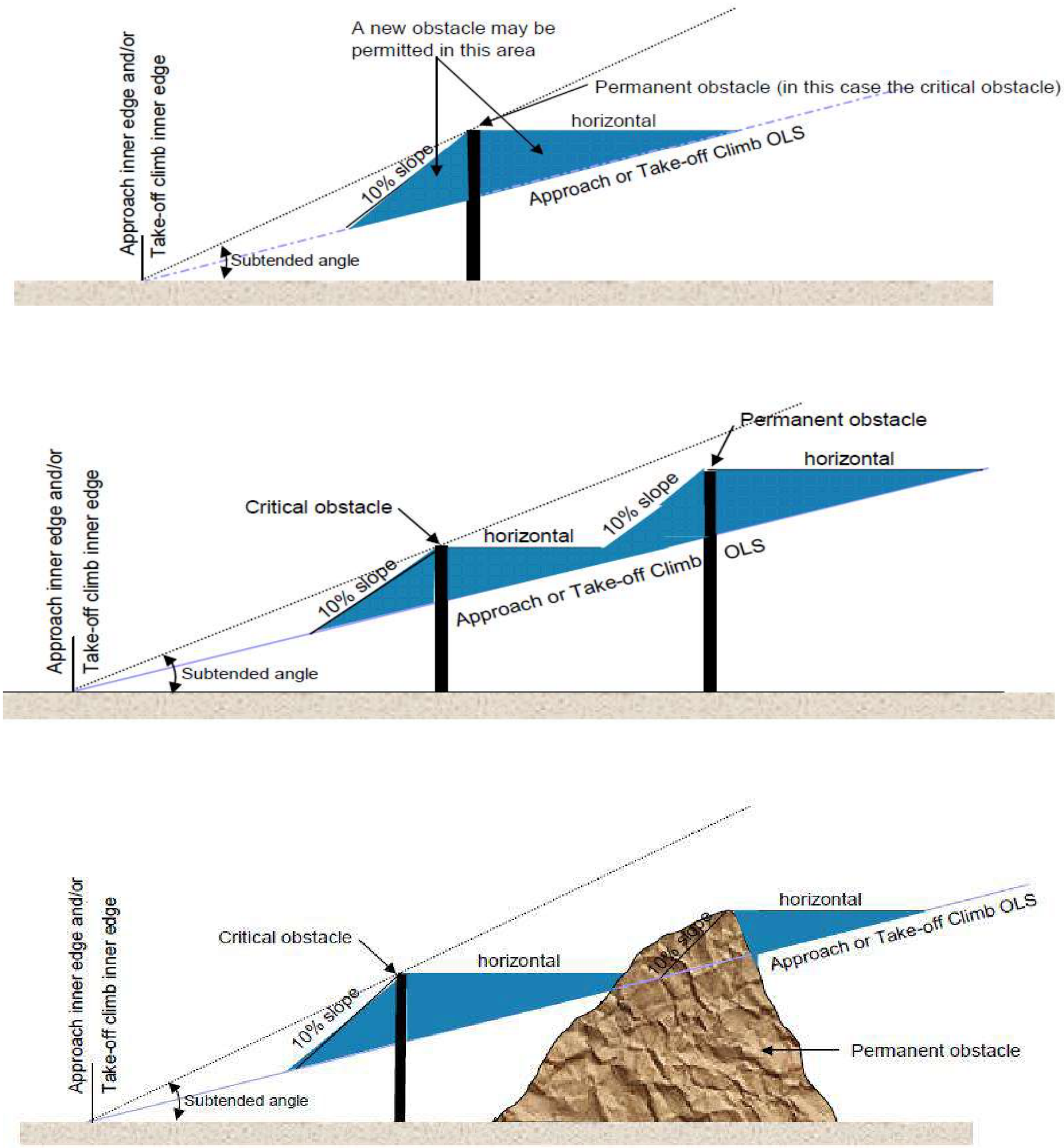

Figure 6-1: Shielding of obstacles penetrating the approach and take-off climb surfaces

7 Aeronautical Study

7.1 An aeronautical study may be conducted to assess the impact of deviations from standards pertaining to obstacle limitation surfaces and to present alternatives means of ensuring safety to aircraft operations, to estimate the effectiveness of the alternatives and to recommend procedures to compensate for the deviation.

7.2 The aeronautical study shall provide justification for the deviation on grounds that an equivalent level of safety can be attained by other means.

7.3 An aeronautical study should evaluate the impact of an obstacle's erection on the instrument and visual flight procedures.

a) Instrument Flight Procedures: In this type of study at least instrument approach procedures, standard instrument departures and standard arrivals should be evaluated. This evaluation shall cover:

1) Instrument procedures currently published in AIP;

2) Those planned for Air Navigation or within the aerodrome Master Plan; and

3) Visual Segment Surface (VSS) of each approach procedure.

b) Visual Flight Procedures: Visual flight procedures currently published in AIP gathered within The Visual Approach Chart (VAC), should be checked. The study should check if an aircraft in visual conditions, on an aerodrome traffic circuit or through the visual tracks with destination/departure to/from the aerodrome, at the notification points determined within the VAC, could be affected by the obstacle/object.

8 Marking and Lighting of Obstacles

8.1 Types of Obstacles

8.1.1 Obstacles can be created in both the aerodrome and en-route environments by a range of structures; some of the most common are transmission masts, pylons, bridges, cooling towers, communication masts and cables. All such obstacles are within the purview of CAD 14, Volume I, although those specifications are specifically published in relation to aerodrome operations.

8.2 Marking

8.2.1 The circumstances in which an obstacle should be marked and techniques for the application of markings are described in CAD 14, Volume I, Chapter 6.

8.2.2 If a flagpole, skeletal structure, or similar object is erected on top of a building, the combined height of the object and building will determine whether marking is required; however, only the height of the object under study determines the width of the colour bands.

8.2.3 If marking is recommended for only a portion of a structure because of shielding by other objects or terrain, or it is not practicable to mark the full structure, the width of the bands should be determined by the overall height of the structure. A minimum of three bands shall be displayed on the upper third of the structure.

8.3 Location of Lighting

8.3.1 The lighting specified in CAD 14. Volume I, Chapter 6, 6.2 provides for a number of system designs. This range of options is necessary to deal with the wide variety of operational systems in an appropriate manner.

8.3.2 For small objects less than 45 m in height, low-intensity lights are normally used. For more extensive objects and for objects having heights greater than 45 m, the use of medium-intensity lights is used. For objects extending more than 150 m above the surrounding ground level, high-intensity obstacle lights will normally be used to meet the operational requirements.

8.3.3 In all cases, a light should be installed as close as is practicable to the highest point on any object regardless of what other lights are provided.

8.3.4 For extensive objects such as a group of buildings, obstacle lights should be positioned to draw attention to the location of all primary corners and edges. When designing systems for night use, it is particularly important to ensure that the position and the extent of the object can be recognised by a pilot. Defining straight lines and corners by an adequate pattern of lights is particularly helpful.

8.3.5 Each obstacle should be the subject of a design study to identify the required layout for that particular situation. The design should conform to CAD 14, Volume I, Chapter 6, 6.2, which also provides examples of obstacle lighting systems for tall structures such as masts and chimneys. The examples given in CAD 14, Volume I, Appendix 5 show how lighting can be selected and applied to meet a wide range of operational situations.

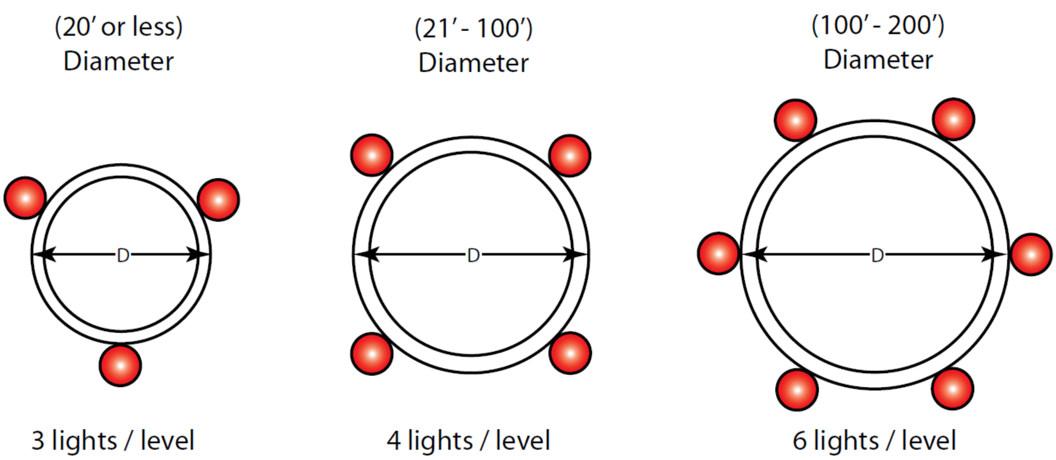

Figure 8-1. Number of lights for chimney

8.3.6 In CAD 14, Volume I, Appendix 5, Figure A5-1, the location details are given for a medium-intensity lighting system. This design can be adopted for obstacles such as communication masts. If the mast has a height in excess of 150 m, consideration should be given to the use of high-intensity lighting. For this case, marking is required if high-intensity lighting is not used. The medium-intensity lighting, Type A, is particularly useful on skeletal masts where weight-carrying capacity is limited and where access for maintenance purposes is not easy to achieve. The design of this layout follows a number of design guidelines. There is a light at the highest point of the structure for all masts 45 m or greater in height. There are at least two lights in the pattern for all masts of 105 m or greater in height. The lights in the pattern are equi-spaced and the space between them is never greater than 105 m. The lowest light is always at or below 105 m.

8.3.7 CAD 14, Volume I, Appendix 5, Figure A5-2 is an example of a dual lighting system suitable for night use only. The pattern consists of alternating 2 000 cd flashing-red and 32 cd fixed-red lights. The low-intensity lights are interspersed between the medium-intensity units, which are spaced in accordance with the parameters given in CAD 14, Volume I, Chapter 6, 6.2.3.25. The flashing lights make this layout conspicuous, but their repetition rate is low. Once the pilot has located the obstacle, the low-intensity fixed lights present a continuous pattern that helps the pilot to retain an awareness of the obstacle. Without this feature, experience has shown that it is possible for a pilot to have only intermittent contact with the obstacle due to the low repetition rate of the flashing light signal. Continuity of visual information is an important requirement that cannot be met solely by lights having low repetition rates. An obstacle lit, as shown in CAD 14, Volume I, Appendix 5, Figure A5-2, should be marked for daytime in conformity with CAD 14, Volume I, Chapter 6, 6.2.

8.3.8 The dual lighting system defined in CAD 14, Volume I, Appendix 5, Figure A5-4 uses a combination of medium-intensity and low-intensity lighting. For daytime use, medium-intensity lights, Type A, must be operated. At night, medium-intensity lights, Type B, are used augmented by low-intensity lights, Type B. In practice, this configuration results in a pattern of 20 000 cd flashing-white lights spaced at intervals of not more than 105 m for daytime use and a pattern of alternate flashing 2 000 cd and fixed 32 cd red lights at night with a spacing half that used for daytime operations. This arrangement is therefore identical to that provided in CAD 14, Volume I, Appendix 5, Figures A5-1 and A5-2 for daytime and for night operations, respectively. The lighting design is particularly useful for objects less than 150 m in height where there is a preference for flashing-white lights by day and flashing-red lights at night.

8.3.9 Where the warning information available from high-intensity lighting must be provided on tall structures, the design guidance given in CAD 14, Volume I, Appendix 5, Figures A5-6 to A5-7 is used. More detailed guidance on the installation of this type of lighting is given below, while CAD 14, Volume I, Appendix 5, Figure A5-6 gives the basic configuration. In CAD 14, Volume I, Appendix 5, Figures A5-7, a dual lighting system is defined that addresses the need to light the highest point on an obstruction in circumstances where the upper part of the structure is not suitable for the attachment of high-intensity light units. This problem is overcome by the use of medium-intensity lighting at that location. At night, as shown in CAD 14, Volume I, Appendix 5, Figure A5-7, the lighting pattern consists of a combination of fixed- and flashing-red lights; no white lights are used in this layout.

8.4 Installation of High-Intensity Obstacle Lighting

8.4.1 High-intensity white obstacle lights are used to indicate the presence of tall structures if their height above the level of the surrounding ground exceeds 150 m, and an aeronautical study indicates such lights to be essential for the recognition of the structure by day. When marking these structures, all lights are flashed simultaneously. High-intensity obstacle lights are also used on the support structures of overhead transmission lines (see Figure 8-2). In this use, the lights are flashed in a specific, vertical, coded sequence which is used not only to identify both the towers and the presence of transmission lines but also to advise pilots that they are approaching a complex obstacle, not an isolated one.

8.4.2 The peak intensity of the light beams should be capable of angular adjustment over the range zero to eight degrees above the horizontal. Normally lights should be installed with the beam peak at zero degrees elevation. Where terrain, nearby residential areas or other situations dictate, it may be beneficial to elevate the light beams of the lower units one or two degrees above the horizontal. The beam of light produced by units at the lower levels should not reach the ground closer than 4.8 km from the structure in order to prevent annoyance to local residents.

8.4.3 High-intensity flashing-white obstacle lights on tall structures should have an effective intensity of not less than 200 000 cd. The intensity of the lights should decrease automatically to 20 000 cd at twilight and 2 000 cd at night-time through the use of photocells.

8.4.4 In the case of a guyed tower or antenna where it is not possible to locate a high-intensity light on the top, a light should be placed at the highest practical point and a medium-intensity obstacle light mounted on the top. Any medium-intensity flashing light should flash in unison with the high-intensity lights installed on the structure. During the day, the medium-intensity white light identifies the top of the structure once the pilot has made visual contact with the high-intensity lighting.

8.4.5 Structures supporting overhead electrical power transmission lines require a unique, vertical, sequentially flashing system to provide adequate warning to pilots of the presence of both the towers and the wires between the towers. Marking systems consisting of paint and medium-intensity red lights do not provide any indication of the presence of transmission lines; a high-intensity lighting system is therefore recommended for this application. Synchronised flashing of the lighting systems on the supporting structures is also recommended.

8.4.6 High-intensity obstacle lights on towers supporting overhead wires should have a daytime intensity of not less than 100 000 cd. The intensity of the lights should decrease to 20 000 cd at twilight and 2 000 cd at night through the use of a photocell control.

8.4.7 Regardless of their height, the structures supporting overhead wires must be marked at three levels. The highest light level should be at the top of the support structure. The actual mounting height may be chosen to provide safe service access to the light. The lowest level should be at the level of the lowest point in the catenary between the two support structures. If the base of the support structure is higher than the lowest point of the catenary, the lowest level should be installed on the adjacent terrain in a manner that ensures unobstructed viewing. The middle level should be the midpoint between the top and bottom levels (see Figure 8-2).

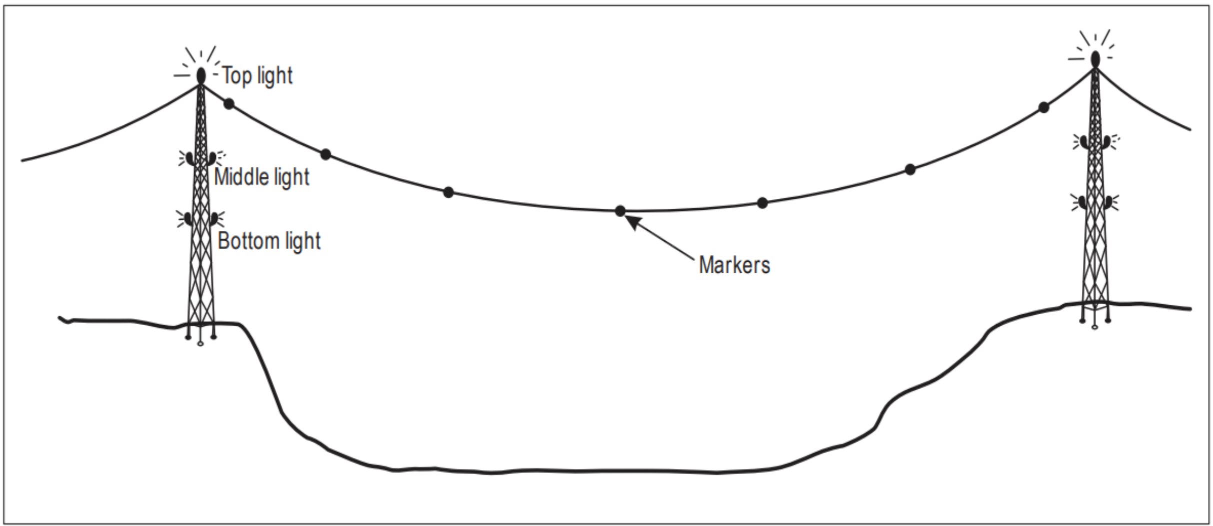

Figure 8-2. Location of high-intensity obstacle lights on towers supporting overhead wires

8.4.8 The number of lights needed per level depends on the outside diameter of the structure being lit. The recommended numbers to obtain proper coverage are as follows:

Diameter	Light units per level
6 m or less	3
6 m to 30 m	4
30 m to 60 m	6
more than 60 m	8

8.4.9 The middle level should flash first, the top level flash second and the bottom level flash last. The interval between the flashing of the top level and the bottom level should be approximately twice the interval between the middle level and the top level. The interval between the end of one sequence and the beginning of the next should be about ten times the interval between the middle level and the top level.

8.4.10 Two or more light units should be installed at each light level and directed on a horizontal plane such as to provide 180 degrees of coverage centred on the transmission line. Where a catenary crossing is situated near a bend in a river, etc., the lights should be directed to provide the most effective light coverage to warn pilots approaching from either direction of the presence of the transmission lines.

8.4.11 High-tension overhead wires present a significant hazard to low-flying aircraft. The span of the wires is often very long. At some locations, high-tension wires cross a valley or river without intermediate supports. This makes lighting of the masts with low- and medium- intensity lights ineffective. In this case, installation of the lights on the wires themselves should be considered.

8.5 Spherical Markers

8.5.1 Spherical markers are used to identify overhead wires. Markers may be of another shape, i.e., cylindrical, provided the projected area of such markers will not be less than that presented by a spherical marker.

Figure 8-3. Spherical marker

8.5.2 Aircraft warning spheres are used as a visual marking of overhead power lines crossing river, waterway, valley or highway or generally where there is a need to make power line visible to aircraft and helicopters. The warning spheres are attached to the shield wires or to the phase conductors.

8.5.3 Where multiple wires, cables, etc. are involved, a marker should be located not lower than the level of the highest wire at the point marked. They should be displayed on the highest wire or by another means at the same height as the highest wire. Where there is more than one wire at the highest point, the markers may be installed alternately along each wire if the distance between adjacent markers meets the spacing standard. This method allows the weight and wind loading factors to be distributed. Where 30 cm spheres are used, intervals between markers should be 10 m to 15 m.

8.5.4 An alternating colour scheme provides the most conspicuousness against all backgrounds. Overhead wires shall be marked by alternating solid coloured markers of international orange and white. An orange sphere is placed at each end of a line and the spacing is adjusted not to exceed the maximum spacing for the applicable size of spheres used to accommodate the rest of the markers. When less than four markers are used, they should all be international orange.

8.6 Monitoring and Maintenance

8.6.1 High-intensity obstacle lights should be monitored continuously through the use of an automatic monitoring system or be checked visually once every 24 hours.

8.6.2 All components in discharge lighting equipment, including the light source, should be designed for ease of maintenance and to provide the specified performance for a period of at least one year without maintenance.

8.7 Autonomous Aircraft Detection System

8.7.1 Where there is a need to minimise obstacle light exposure to local residents, an autonomous aircraft detection system may be installed so that obstacle lighting is operated only when required by an approaching aircraft. Sensor-based systems should be used, which are designed to turn the obstacle lighting on when an approaching aircraft enters a predetermined detection area and to subsequently turn the obstacle lighting off when the aircraft leaves the detection area, or when a predetermined period from the end of detection of the aircraft has expired.

8.7.2 The benefit of using such a detection system is that residents are exposed to the lighting only when it is actually needed by an aircraft. In designing such a system, care must be taken such that the system is:

a) autonomous;

b) capable of detecting an aircraft prior to entering a volume of airspace or coverage area around the obstacle (or group of obstacles);

c) capable of detecting an aircraft prior to a specified time or distance, which is sufficient for the pilot to recognise activation of the lighting and initiate a turn that enables avoidance of the object(s) by the required horizontal separation distance;

d) capable of turning the lights on in the event of a failure of the detection system; and

e) if transponder-based, only used when all affected aircraft within a three-dimensional volume of airspace or coverage area around the obstacle or group of obstacles are equipped with a transponder.

Note.— If an autonomous aircraft detection system is used to turn the obstacle lights on and off, affected pilots need to be notified by appropriate means (e.g. Aeronautical Information Publication (AIP), VFR-charts).

9 Appendices

9.1 Appendix 1 – Application for Approval of Height Limitation

1 The applicant is to obtain the up-to-date application form (CAAM/ASD/OLS/01) in CAAM website www.caam.gov.my.

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