CIVIL AVIATION AUTHORITY OF FIJI

STANDARDS DOCUMENT

Appendix 6
Visual Aids For Denoting Obstacles

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Civil Aviation Authority of Fiji
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VISUAL AIDS FOR DENOTING OBSTACLES

1.0 INTRODUCTION

1.1 This appendix expands on the requirements of SD-AD chapter 3 pertaining to obstacles and hazards.

1.2 The marking and/or lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce operating limitations which may be imposed by an obstacle.

2.0 Objects to be marked and/or lighted

2.1 Objects within the lateral boundaries of the obstacle limitation surfaces

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

2.1.2 Elevated aeronautical ground lights within the movement area shall be marked so as to be conspicuous by day. Obstacle lights shall not be installed on elevated ground lights or signs in the movement area.

2.1.3 All obstacles within the distance specified in Table 1, column 11 or 12, from the centre line of a taxiway, an apron taxiway or aircraft stand taxilane shall be marked and, if the taxiway, apron taxiway or aircraft stand taxilane is used at night, shall also be lighted.

2.1.4 A fixed obstacle that extends above a take-off climb surface within 3000m of the inner edge of the take-off climb surface *should* be marked and, if the runway is used at night, lighted, except that:

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

(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

2.1.5 A fixed object, other than an obstacle, adjacent to a take-off climb surface *should* be marked and, if the runway is used at night, lighted, if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:

(a) the object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150m; or

(b) the object is lighted by high-intensity obstacle lights by day.

2.1.6 A fixed obstacle that extends above an approach surface within 3000m of the inner edge or above a transitional surface shall be marked and, if the runway is used at night, lighted, except that:

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

(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

2.1.7 A fixed obstacle that extends above a horizontal surface *should* be marked and, if the aerodrome is used at night, lighted, except that:

(a) such marking and lighting may be omitted when:

(1) the obstacle is shielded by another fixed obstacle; or

(2) for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or

(3) an aeronautical study shows the obstacle not to be of operational significance;

(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

2.1.8 A fixed object that extends above an obstacle protection surface shall be marked and, if the runway is used at night, lighted.

2.1.9 Other objects inside the obstacle limitation surfaces *should* be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).

2.1.10 Overhead wires, cables, etc., crossing a river, waterway, valley or highway *should* be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.

2.2 Objects outside the lateral boundaries of the obstacle limitation surfaces

2.2.1 Obstacles in areas beyond the limits of the obstacle limitation surfaces which extend to a height of 150 m or more above ground elevation shall be regarded as obstacles, and unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes *should* be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

2.2.2 Other objects outside the obstacle limitation surfaces *should* be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway, highway).

2.2.3 Overhead wires, cables, etc., crossing a river, waterway, valley or highway *should* be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.

3.0 Marking and/or lighting of objects

3.1 General

3.1.1 The presence of objects which must be lighted, as specified in section 2.0, shall be indicated by low-, medium- or high- intensity obstacle lights, or a combination of such lights.

3.1.2 Low-intensity obstacle lights, Types A B, C, D and E, medium-intensity obstacle lights, Types A, B and C, high-intensity obstacle lights Type A and B, shall be in accordance with the specifications in Table 1 and *ICAO Annex 14 Appendix 1*.

3.1.3 The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

3.2 Mobile objects Marking

3.2.1 All mobile objects to be marked shall be coloured or display flags.

Marking by colour

3.2.2 When mobile objects are marked by colour, a single conspicuous colour, preferably red or yellowish green for emergency vehicles and yellow for service vehicles, *should* be used.

Marking by flags

3.2.3 Flags used to mark mobile objects shall be displayed around, on top of, or around the highest edge of the object. Flags shall not increase the hazard presented by the object they mark.

3.2.4 Flags used to mark mobile objects shall not be less than 0.9 m on each side and shall consist of a chequered pattern, each square having sides of not less than 0.3 m. The colours of the pattern shall contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white shall be used, except where such colours merge with the background.

Lighting

3.2.5 Low-intensity obstacle lights, Type C, shall be displayed on vehicles and other mobile objects excluding aircraft.

3.2.6 Low-intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security shall be flashing-blue and those displayed on other vehicles shall be flashing-yellow.

3.2.7 Low-intensity obstacle lights, Type D, shall be displayed on follow-me vehicles.

3.2.8 Low-intensity obstacle lights on objects with limited mobility such as aerobridges 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.

Table 1 - Characteristics of obstacle lights

1	2	3	4	5	6	7
Light Type	**Colour**	**Signal type/ (flash rate)**	**Peak intensity (cd) at given Background Luminance (b)**			**Light distribution table**
			Day (Above 500 cd/m²)	**Twilight (50-500 cd/m²)**	**Night (Below 50 cd/m²)**	
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	Table 2
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	Table 2
Low-intensity, Type C (mobile obstacle	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40	40	Table 2
Low-intensity, Type D (follow-me vehicle)	Yellow	Flashing (60–90 fpm)	N/A	200	200	Table 2
Low-intensity, Type E	Red	Flashing (c)	N/A	N/A	32	Table 2 (Type B)
Medium-intensity, Type A	White	Flashing (20–60 fpm)	20 000	20 000	2 000	Table 3
Medium-intensity, Type B	Red	Flashing (20–60 fpm)	N/A	N/A	2 000	Table 3
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2 000	Table 3
High-intensity, Type A	White	Flashing (40–60 fpm)	200 000	20 000	2 000	Table 3
High-intensity, Type B	White	Flashing (40–60 fpm)	100 000	20 000	2 000	Table 3

a) see 3.2.6

b) For flashing lights, effective intensity as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4

c) For wind turbine application, to flash at the same rate as the lighting on the nacelle.

Table 2 - Light distribution for low-intensity obstacle lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (c)	400 cd	N/A (e)	N/A

Note. — This table does not include recommended horizontal beam spreads. 3.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

d) Peak intensity *should* be located at approximately 2.5° vertical.

e) Peak intensity *should* be located at approximately 17° vertical.

f) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Table 3 - Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table 1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

Note. — This table does not include recommended horizontal beam spreads.3.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.

c) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Note. — An extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

3.3 Fixed objects

Note. — The fixed objects of wind turbines are addressed separately in 3.4 and the fixed objects of overhead wires, cables, etc., and supporting towers are addressed separately in 3.5.

Marking

3.3.1 All fixed objects to be marked shall, whenever practicable, be coloured, but if this is not practicable, markers or flags shall be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size or colour need not be otherwise marked.

Marking by colour

3.3.2 An object *should* be coloured to show a chequered pattern if it has essentially unbroken surfaces and its projection on any vertical plane equals or exceeds 4.5m in both dimensions. The pattern *should* consist of rectangles of not less than 1.5m and not more than 3m on a side, the corners being of the darker colour. The colours of the pattern *should* contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white *should* be used, except where such colours merge with the background. (See Figure 1.)

3.3.3 An object *should* be coloured to show alternating contrasting bands if:

(a) it has essentially unbroken surfaces and has one dimension, horizontal or vertical, greater than 1.5m, and the other dimension, horizontal or vertical, less than 4.5m; or
(b) it is of skeletal type with either a vertical or a horizontal dimension greater than 1.5m.

The bands *should* be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30m, whichever is less. The colours of the bands *should* contrast with the background against which they will be seen. Orange and white *should* be used, except where such colours are not conspicuous when viewed against the background. The bands on the extremities of the object *should* be of the darker colour. (See Figures 1 and 2.)

Note. — Table 4 shows a formula for determining band widths and for having an odd number of bands, thus permitting both the top and bottom bands to be of the darker colour.

3.3.4 An object *should* be coloured in a single conspicuous colour if its projection on any vertical plane has both dimensions less than 1.5m. Orange or red *should* be used, except where such colours merge with the background.

Note. — Against some backgrounds it may be found necessary to use a different colour from orange or red to obtain sufficient contrast.

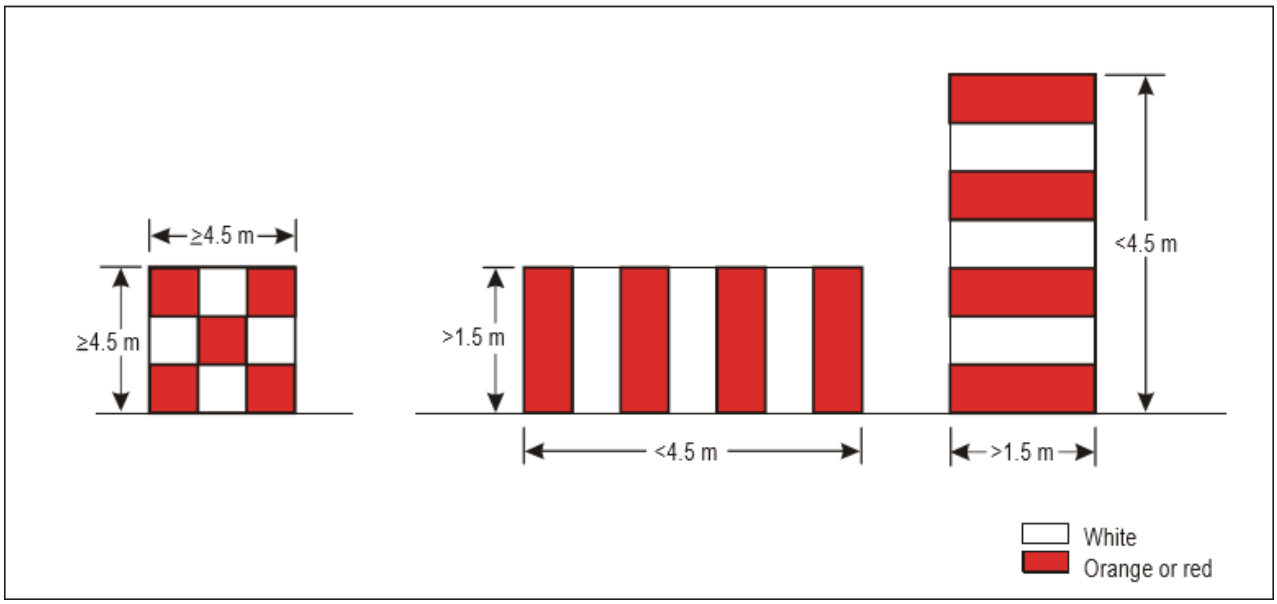

Figure 1 - Basic marking patterns

Table 4 - Marking band widths

Longest dimension		Band width
Greater than	Not exceeding	
1.5m	210m	1/7 of longest dimension
210m	270m	1/9 of longest dimension
270m	330m	1/11 of longest dimension
330m	390m	1/13 of longest dimension
390m	450m	1/15 of longest dimension
450m	510m	1/17 of longest dimension
510m	570m	1/19 of longest dimension
570m	630m	1/21 of longest dimension

Marking by flags

3.3.5 Flags used to mark fixed objects shall be displayed around, on top of, or around the highest edge of, the object. When flags are used to mark extensive objects or groups of closely spaced objects, they shall be displayed at least every 15m. Flags shall not increase the hazard presented by the object they mark.

3.3.6 Flags used to mark fixed objects shall not be less than 0.6m on each side.

3.3.7 Flags used to mark fixed objects *should* be orange in colour or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colours merge with the background, other conspicuous colours *should* be used.

Marking by markers

3.3.8 Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1000m for an object to be viewed from the air and 300m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.

3.3.9 A marker *should* be of one colour. When installed, white and red, or white and orange markers *should* be displayed alternately. The colour selected *should* contrast with the background against which it will be seen.

Lighting

3.3.10 In the case of an object to be lighted, one or more low-, medium- or high-intensity obstacle lights shall be located as close as practicable to the top of the object.

Note. — Recommendations on how a combination of low-, medium- and/or high-intensity lights on obstacles should be displayed are given in Annex 14 Appendix 5.

3.3.11 In the case of chimney or other structure of like function, the top lights *should* be placed sufficiently below the top so as to minimize contamination by smoke, etc. (See Figure 2).

3.3.12 In the case of a tower or antenna structure indicated by high-intensity obstacle lights by day with an appurtenance, such as a rod or an antenna, greater than 12m where it is not practicable to locate a high-intensity obstacle light on the top of the appurtenance, such a light shall be located at the highest practicable point and, if practicable, a medium-intensity obstacle light, Type A, mounted on the top.

3.3.13 In the case of an extensive object or of a group of closely spaced objects to be lighted that are:

(a) penetrating a horizontal obstacle limitation surface (OLS) or located outside an OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface or above the ground, and so as to indicate the general definition and the extent of the objects; and

(b) penetrating a sloping OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the OLS, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area shall be marked.

3.3.14 When the obstacle limitation surface concerned is sloping and the highest point above the OLS is not the highest point of the object, additional obstacle lights *should* be placed on the highest point of the object.

3.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

(a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45m; and
(b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900m.

3.3.16 High-intensity obstacle lights, Type A, and medium-intensity obstacle lights, Types A and B, located on an object shall flash simultaneously.

3.3.17 The installation setting angles for high-intensity obstacle lights, Type A, *should* be in accordance with Table 5.

Note. — High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, location and operation of high-intensity obstacle lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

3.3.18 Where, in the opinion of the Authority, the use of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system *should* be provided. This system *should* be composed of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle lights, Type B or C, for night-time use.

Lighting of objects with a height less than 45 m above ground level

3.3.19 Low-intensity obstacle lights, Type A or B, *should* be used where the object is a less extensive one and its height above the surrounding ground is less than 45m.

3.3.20 Where the use of low-intensity obstacle lights, Type A or B, would be inadequate or an early special warning is required, then medium- or high-intensity obstacle lights *should* be used.

3.3.21 Low-intensity obstacle lights, Type B, *should* be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with 3.3.22.

3.3.22 Medium-intensity obstacle lights, Type A, B or C, *should* be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, *should* be used alone, whereas medium-intensity obstacle lights, Type B, *should* be used either alone or in combination with low-intensity obstacle lights, Type B.

Note. — A group of buildings is regarded as an extensive object.

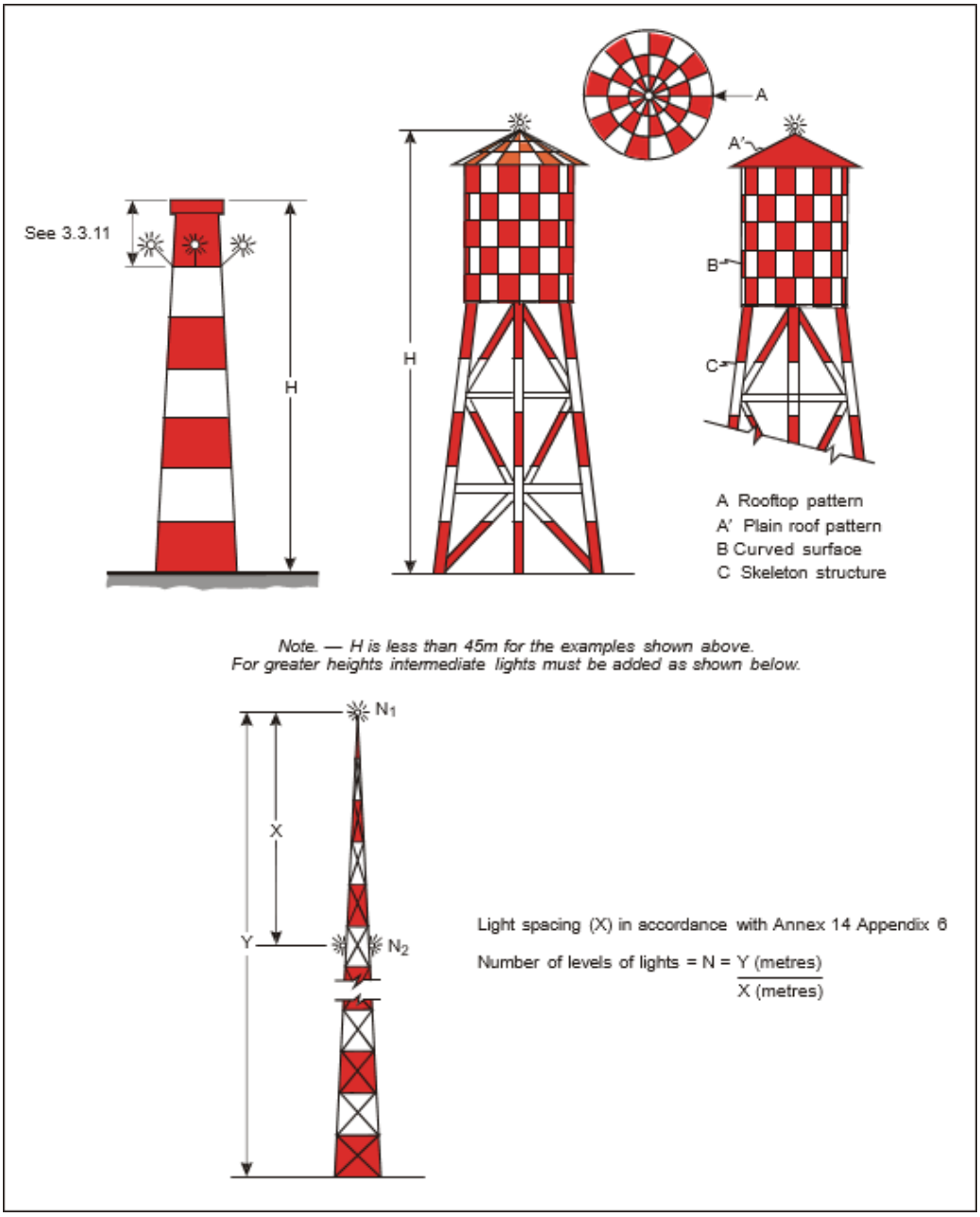

Figure 2 -Examples of marking and lighting of tall structures

Lighting of objects with a height 45 m to a height less than 150 m above ground level

3.3.23 Medium-intensity obstacle lights, Type A, B or C, *should* be used. Medium-intensity obstacle lights, Types A and C, *should* be used alone, whereas medium-intensity obstacle lights, Type B, *should* be used either alone or in combination with low-intensity obstacle lights, Type B.

3.3.24 Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105m.

3.3.25 Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52m.

3.3.26 Where an object is indicated by medium-intensity obstacle lights, Type C, and the top of the object is more than 45m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52m.

3.3.27 Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105m between the ground level and the top light(s) specified in 3.3.10, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

Lighting of objects with a height 150 m or more above ground level

3.3.28 High-intensity obstacle lights, Type A, *should* be used to indicate the presence of an object if its height above the level of the surrounding ground exceeds 150m and an aeronautical study indicates such lights to be essential for the recognition of the object by day.

3.3.29 Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105m between the ground level and the top light(s) specified in 3.3.10, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

3.3.30 Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10,000m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Type C, *should* be used alone, whereas medium- intensity obstacle lights, Type B, *should* be used either alone or in combination with low-intensity obstacle lights, Type B.

3.3.31 Where an object is indicated by medium-intensity obstacle lights, Type A, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105m.

3.3.32 Where an object is indicated by medium-intensity obstacle lights, Type B, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52m.

3.3.33 Where an object is indicated by medium-intensity obstacle lights, Type C, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52m.

3.4 Wind turbines

3.4.1 A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.

Note — Additional lighting or markings may be provided where in the opinion of the Authority such lighting or markings are deemed necessary.

Markings

3.4.2 The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines *should* be painted white, unless otherwise indicated by an aeronautical study.

Lighting

3.4.3 When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm *should* be regarded as an extensive object and the lights *should* be installed:

(a) to identify the perimeter of the wind farm;
(b) respecting the maximum spacing, in accordance with 3.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;
(c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;

(d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and

(e) at locations prescribed in a), b) and d), respecting the following criteria:

1) for wind turbines of less than 150m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle *should* be provided;
2) for wind turbines from 150m to 315m in overall height, in addition to the medium- intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and
3) in addition, for wind turbines from 150m to 315m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in

3.1.3 should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.

Note. — The above 3.4.3 e) does not address wind turbines of more than 315m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

3.4.4 The obstacle lights *should* be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

3.4.5 Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation *should* be in accordance with 3.4.3 e) or as determined by an aeronautical study.

3.5 Overhead wires, cables, etc., and supporting towers Marking

3.5.1 The wires, cables, etc., to be marked *should* be equipped with markers; the supporting tower *should* be coloured.

Marking by colours

3.5.2 The supporting towers of overhead wires, cables, etc., that require marking *should* be marked in accordance with 3.3.1 to 3.3.4, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

Marking by markers

3.5.3 Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1000m for an object to be viewed from the air and 300m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.

3.5.4 A marker displayed on an overhead wire, cable, etc., *should* be spherical and have a diameter of not less than 60cm.

3.5.5 The spacing between two consecutive markers or between a marker and a supporting tower *should* be appropriate to the diameter of the marker, but in no case *should* the spacing exceed:

(a) 30m where the marker diameter is 60cm progressively increasing with the diameter of the marker to
(b) 35m where the marker diameter is 80cm and further progressively increasing to a maximum of
(c) 40m where the marker diameter is of at least 130cm.

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.

3.5.6 A marker *should* be of one colour. When installed, white and red, or white and orange markers *should* be displayed alternately. The colour selected *should* contrast with the background against which it will be seen.

3.5.7 When it has been determined that an overhead wire, cable, etc., needs to be marked but it is not practicable to install markers on the wire, cable, etc., then high-intensity obstacle lights, Type B, *should* be provided on their supporting towers.

Lighting

3.5.8 High-intensity obstacle lights, Type B, *should* be used to indicate the presence of a tower supporting overhead wires, cables, etc., where:

(a) an aeronautical study indicates such lights to be essential for the recognition of the presence of wires, cables, etc.; or

(b) it has not been found practicable to install markers on the wires, cables, etc.

3.5.9 Where high-intensity obstacle lights, Type B, are used, they shall be located at three levels:

(a) at the top of the tower;
(b) at the lowest level of the catenary of the wires or cables; and
(c) at approximately midway between these two levels.

Note. — In some cases, this may require locating the lights off the tower.

3.5.10 High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., *should* flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights *should* approximate the following ratios:

Flash interval between	**Ratio of cycle time**
middle and top light	1/13
top and bottom light	2/13
bottom and middle light	10/13.

Note. — High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, operation and the location of high-intensity obstacle lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

3.5.11 Where, in the opinion of the Authority, the use of high-intensity obstacle lights, Type B, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10,000m radius) or cause significant environmental concerns, a dual obstacle lighting system *should* be provided. This system *should* be composed of high-intensity obstacle lights, Type B, for daytime and twilight use and medium-intensity obstacle lights, Type B, for night- time use. Where medium-intensity lights are used they *should* be installed at the same level as the high- intensity obstacle light Type B.

3.5.12 The installation setting angles for high-intensity obstacle lights, Type B, *should* be in accordance with Table 5.

Table 5 - Installation setting angles for high-intensity obstacle lights

Height of light unit above terrain (AGL)		**Angle of the peak of the beam above the horizontal**
Greater than	**Not exceeding**	
151m		0°
122m	151m	1°
92m	122m	2°
	92m	3°