Transport Canada Transports Canada

Flight Standards

Standard 621
OBSTRUCTION MARKING AND LIGHTING

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Canada

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1. PURPOSE.

The purpose of this publication is to provide standards for marking and lighting of objects that present a hazard to the safe operation of aircraft.

2. EFFECTIVE DATE.

The requirements of this edition are effective 30 days after the date of publication.

3. CANCELLATION.

The Standard 621, Obstruction Marking and Lighting, 1st Edition, dated 31 December 2011 is cancelled by this publication.

3. STANDARDS CHANGES AND EXISTING FACILITIES

3.1 Unless otherwise directed by the Minister, existing installations of marking and/or lighting do not need to be upgraded if installed prior to the effective date of this 2nd edition, with the exception of installations as indicated in CAR601.26 for which there is an external change [e.g. removal of a shielding object or air traffic pattern].

4. APPLICATION

In accordance with CAR 601.24, persons having responsibility for or control over a building or object that constitutes an obstacle to air navigation shall either mark and light the building, structure or object in accordance with the requirements of Standard 621, or use equivalent marking and lighting approved by the Minister .

6. EXPLANATION OF CHANGES

Old article 1.2. Moved to Chapter 2, article 2.5.

New article 1.2. Abbreviations added

Article 2.1. **Purpose of Marking and Lighting Requirements.** Added information notes and tables to explain lighting criteria and aircraft acquisition distance. This gives the rationale for light intensities.

Article 2.2(5)(a). Removed "objects such as a bridge", since subject is catenaries. Shielding by bridges will be subject to a Ministerial evaluation.

Article 2.2(5)(b). Separation distance is changed to 300m from 600m so as to be consistent with the observation distance for catenary wire markers.

Figure 2-2. Added note for markers on one counterpoise.

Article 2.3(1). Added reference to ISO/IEC Guide 17025.

Article 2.4. Removed "*as defined by the applicable zoning law"* since the use of high intensity lighting may not be in the zoning law, but the proponent should still check with the authority having local jurisdiction.

New article 2.5(3). For catenaries and other objects over navigable waterways, the proponent should contact the local Navigation Protection Program (NPP) office.

New article 2.5(4). The previous recommendation is raised to a standard.

New article 2.6. **Correction of Lighting Failure** Allows non-notification of failure for steady burning lights

New article 2.7. **Light Failure Notification** added. This expands upon article 4.7(7) in the previous edition.

New article **2.8. Object Height Tolerance** to accommodate installation that may have FAA tower heights levels. This provides a transition from imperial to metric dimensions.

New article 3.8. For crane marking and lighting.

Article 4.1. Removal of "marking requirements of catenary wires, catenary support structures, moored balloons and kites, for daytime" which are addressed in the pertinent chapters.

Table 4-2. Added alternative red for reduction of bird fatalities.

Article 4.2(3). Information Note 2. Added exception for rotating CL-865 regarding installation at heights less than 60 m.

Article 4.2(5). Note d'information. Removed, since the issue is addressed elsewhere.

Article 4.3. **Floodlighting** deleted because the visibility of the objects is dependent upon the angle of light projection and the reflectivity of the object. The proponent can still propose floodlighting as an equivalent, however this would be subject to specific evaluation.

Article 4.7. **Monitoring of Obstruction Lights** significantly revised to put the onus of responsibility to "know" on the proponent. Various methods are identified. Inspection is obviated if the method includes self-diagnosis. Figure 4-2 is added as information.

Article 5.1. Added information note

Article 5.2(2). Moved in sequence to follow the format of FAA AC 70/7460-1

New article 5.3(2)(e). Statement that beacons are on the outside of the tower. This resolves the issue obscuring of lights placed interior to the tower.

Figure 5-2. Revised to follow 5.3(2)(e)

New article 5.4 **Alternative Configuration A to reduce bird fatalities.** To allow reduction of lights to minimize bird fatalities. This adopts the FAA practice.

Article 5.5 **Chimneys, Flare Stacks and Similar Solid Structures.** Revised for clarity.

Article 5.8 **Groups of Objects.** Revised for clarity.

New article 5.10. **Ice Shields.** To address the application of ice shields to prevent damage to lights

New article 5.11. Lighting of Cranes. Essentially following the Japanese standard.

Article 6.1. New information note to make a distinction between medium intensity flashing lights of the strobe-type and rotating-type.

New article 6.2. **Application.** To require synchronous flashing of medium intensity lights.

Article 6.4. New information note concerning lighting of appurtenances.

Article 6.4 (4). Removed item (c), since this is a recommendation.

Figure 6-1. Revised to reference article 6.4(4).

New article 6.4(5). Requirements for omitting paint for heights under 150 m.

Paragraphe 6.4(6). Requirement for painting for heights over 150 m.

New article 6.7. **Prominent Buildings and Similar Extensive Obstructions.** Adopts FAA practice.

Figure 7-4. High intensity lighting ends at 150 m. This reflects established practice.

Article 7.5(2). New information notes to interpret requirements for lighting appurtenances.

Article 7.7(4). Requirements for objects exceeding 60 m for both dimensions.

New article 8.2(3). For combined CL-865 et CL-864 lights.

Article 8.3. New information note concerning control.

Article 10.3. **Markers.** Revised to separately address structure markers and shore markers.

New article 10.4(1)(e). Provides criteria [1000m distance] for assessment of wire markers of shapes other than spherical.

New article 10.4(1)(f). Provides criteria for markers near runway ends.

Paragraphe 10.6(2). New information note on the use of lighting. Example is that of an installation in Hong Kong.

Article 10.7. **Lighting of Catenary Support Structures.** Introduces 5 configurations of lighting.

New figure 10-4. Lighting configurations for catenaries.

Article 10.7(2). Allows use of lighting place of marking as for other skeletal structures.

Article 10.8. **Lighting with use of Aircraft Detection System (ADS).** Revised to stress the need for assessment and approval by the Minister.

New article 10.9. **Site Maintenance / Clearance.** Added to emphasize clearing of obscuring vegetation.

Chapter 11 - **Marking and Lighting of Tethered Objects**. Chapter renamed to give pertinence to tethered objects.

New article 11.1(2). Identification of winched gliders as not part of this chapter for reason that the exposed tether is not permanent.

New article 11.3. **Tethered objects more than 150m AGL.** New article for tethered objects more than 150m in height. This is to address tethered generators and windsails that are more than 150m AGL.

Figure 12-1. Revised to show inner dominant windturbine.

Article 12.2(1)(a). Paint required only for top 2/3 of the support mast. This reflects established practice.

New article. 12.2(1)(b). Paint required for lattice-work support masts.

Article 12.2(1). Added orange colour to the information note.

Article 12.2(2). Emphasis added for twilight and night protection.

Article 12.2(2) (b)(iii). Lighting may be necessary for more than one windturbine.

Article 12.3. **Wind turbines of Total Height Exceeding 150 m.** Revised to provide requirements for windturbines of more than 150m. by adopting international practice.

New figure 12-2. Illustration of lighting required to 315 m.

New article 12.5. **Temporary Lighting During Construction.** Adopts FAA practice for temporary lighting.

New article 12.6. **MET Towers (meteorological towers).** Adopts FAA practice for marking MET towers.

Revision of table 13-1. Clarifies the photocell settings. Settings in footcandles are given to match actual units for supplied photocells.

New table 13-2. **Control Settings**. Provided to put the lighting control in one location.

New table 13-3. **Characteristics of obstacle lights.** Adopts ICAO practice whilst maintaining FAA practice for such as for CL-856 and CL-857.

New table 13-4. **Minimum Intensity and light distribution for low-intensity obstacle lights (Figure 13-1).** Continues Transport Canada practice for CL-810 which follows ICAO practice for low intensity type B, albeit the beam is +2.5 to +12.5 degrees.

New table 13-5a. **Minimum Effective intensities of flashing lights (a) (Figure 13-2).** Adopts ICAO practice that the minimum intensities are standards.

New table 13-5b. **Recommended maximum effective intensities of flashing lights (a)(d) (Figure 13-2).** Adopts ICAO practice that the maximum intensities are recommendations.

Table 13-5(f). Provides specification for the intensity of the red beam.

New figures 13-1 and 13-2. Illustrates the photometric requirements for low, medium and high intensity obstacle lights.

New article 14.2(2). Provides inspection frequency for powerline markers.

Article 15.1. **Scope.** Use of the word "sensor" in place of "radar" in order to avoid prescriptive terminology. This change is applied throughout the chapter 15.

Article 15.2. **Impact Boundary.** Revises horizontal distance from the object as 30m to 60m.

Article 15.3(5)(a). Makes the provision of an audio signal optional for all but catenary crossings.

Article 15.3(6). Warning Zones. Information note revised for clarity.

Chapter 1 - Introduction

1.1 Definitions

In this Standard:

“appurtenance” – (Note: this term is defined as "projection" in the CARs) means that part of any vertical mast, pole or other appendage added to a building, structure or object that protrudes above the top of the building, structure or object; (accessoire)

“aviation colours” – for lighting, the colours as defined in the ICAO Annex 14; (couleurs)

“beam spread” – means the angle between the two directions in the vertical or horizontal plane in which the intensity is equal to 50 percent of the minimum specified peak beam effective intensity; (angle d’ouverture du faisceau)

“catenary” – means the curved span of overhead wires hung freely between two supporting structures, normally with regard to exceptionally long elevated spans over canyons, rivers and deep valleys; (caténaire)

“effective intensity” – means the effective intensity of a flashing light is equal to the intensity of a steady-burning (fixed) light of the same color which produces the same visual range under identical conditions of observation; (intensité efficace).

“fixed light” – means a light having constant luminous intensity when observed from a fixed point; (feu fixe)
“lighting” – means any light displayed on an obstruction as a means of indicating the presence of the obstruction to pilots; (éclairage)

“lighting terms” – refer Figure 1-1 (unités photométriques)

(a) Lumen - International System unit of luminous flux equal to the amount of light given out through a solid angle of 1 steradian by a point source of 1 candela intensity radiating uniformly in all directions. The unit expresses the quantity of light output per second. lumen)

(b) Candela - International System unit of luminous intensity of light emitted from a light source; equal to 1/60 of the luminous intensity per square centimetre of a blackbody radiating at the temperature of solidification of platinum (2,046 degrees Kelvin). A luminous intensity of one candela is one lumen per steradian (solid angle). The unit expresses the intensity of light within an incremental segment of the beam. (candela)

(c) Lux - International System unit of illumination, equal to one lumen per square metre (lm/m^2). The unit expresses the amount of light falling on the surface area. (lux)

“marker” – means an object displayed on an obstruction during daytime as a means of indicating the presence of relatively invisible obstructions such as power lines; (balise)

“marking” – means a symbol, group of symbols, or markers that are displayed on the surface of an obstruction and intended to reduce hazards to aircraft by indicating the presence of the obstruction by day; (balisage)

“meteorological visibility” – means the greatest distance, expressed in statute miles, that selected objects (visibility markers) or lights of moderate intensity at night (25 candela) can be seen and identified under specific conditions of observation; (visibilité météorologique)

“painting” – means a marking applied to the surface of an obstruction and intended to identify the presence of the obstruction by day; (marque de peinture)

“vertical aiming angle” – means the angle formed between the horizontal and a line through the centre of the vertical beam spread. (calage en site)

“wind turbine” means a structure intended for the production of electrical power; comprising a support mast on which is installed a nacelle containing a generator unit and which supports rotor blades that are caused to rotate by

the wind. The total height of the obstruction is the height of the nacelle, above ground level (AGL), plus the length of one of the blades held in a vertical position. (éolienne)

“wind farm” means a grouping of 3 or more wind turbines. (parc d’éoliennes)

“wind farm indicators” means light units installed with specified spacing on selected wind turbines and serving to indicate the location of a wind farm to pilots. (indicateurs de parc d’éoliennes)

~~**1.2 Notification Responsibilities**~~

~~(1) A person planning to erect or modify an obstruction, namely a building, structure or object, including a moored balloon or kite, either permanently or temporarily, contact the appropriate regional Transport Canada Civil Aviation office, as specified in Appendix A , at least 90 days prior to erection and provide the information on the planned obstruction, using the Aeronautical assessment form for obstruction marking and lighting as shown in Appendix C:~~

~~(2) If it appears that planned construction might create an obstruction to air navigation in the vicinity of a Department of National Defence (DND) aerodrome, the person having responsibility or control over the construction advise the appropriate DND authorities.~~

~~**Information Note:** Any person planning to erect an obstruction should also provide information to Nav Canada, using the “Land Use Proposal Submission Form” (« Projet d'utilisation particulière d'un terrain ») which is available from the appropriate Transport Canada regional office. (See Appendix A)~~

~~**Information Note:** Where possible, for objects such as broadcast antennae and wind farms, a sign identifying the owner of the object and providing contact information should be installed at the entrance gate or any other place as appropriate.~~

1.2 Abbreviations and symbols used in this Standard

AGL	Above Ground Level
cd	Candela (light intensity)
km/h	Kilometre per hour
m	Metre
kt	Knot
FAA	Federal Aviation Administration (USA)
cm	Centimetre
ft	Foot
ICAO	International Civil Aviation Organization
max	Maximum
min	Minimum
ADS	Aircraft Detection System
FIC	Flight Information Centre
< x	less than x
> x	more than x
≥ x	equal to or more than x
≤ x	equal to or less than x

Chapter 2 - General

2.1 Purpose of Marking and Lighting Requirements

*Information Note 1**:** The application of the marking and lighting requirements specified in this Standard and the approval of equivalent requirements is to ensure that an obstruction to air navigation remains visible at a range sufficient to permit a pilot in VMC conditions to take appropriate action in order to avoid the obstruction, by not less than 300 m vertically within a horizontal radius of 600 m from the obstruction. The ~~In other words, the~~ purpose of obstruction marking and lighting standards is to provide an effective means of indicating the presence of objects likely to present a hazard to aviation safety. Equivalent lighting and marking requirements may ~~can~~ be approved depending on terrain features, weather patterns, geographic location, and in the case of wind turbines, depending on the number of structures and overall layout of design. ~~in accordance with the criteria and procedures outlined in sections 2.2 and 2.3. below~~.*

Information note 2: Guyed Structures. The guys of a 610 m [2000 foot] skeletal tower are anchored from 490 m (1600 feet) to 610 m (2000 feet) from the base of the structure. This places a portion of the guys 460 m (1500 feet) from the tower at a height of between 38m (125 feet) to 150 m (500 feet) AGL. It is expected that pilots, when operating over other than congested areas, to remain at least 150 m (500 feet) from manmade structures. Therefore, the tower must be cleared by 150 + 460 = 610 m (2000 feet) horizontally to avoid all guy wires. Properly maintained marking and lighting are important for increased conspicuity since the guys of a structure are difficult to see until aircraft are dangerously close.

*Information note 3: Intensity Requirements**.** An aircraft travelling at 250 knots (463 km/hr) requires 1.48 statute miles (2.4 km) to avoid an object horizontally by 610m (2000 feet) once the pilot sees the obstruction light, recognizes the light as marking an obstruction, initiates evasive action and allowing for aircraft lag. An aircraft travelling at 165 knots (306 km/hr) requires 1.18 statute miles (1.9 km) to avoid an obstruction by 610 m horizontally. The lighting in Standard 621 provides the acquisition distances: for the 250 knot aircraft ... 32 cd nominal intensity in 3 statute mile visibility; and for the 165 knot aircraft ... 2000 cd nominal intensity in 1 statute mile visibility.*

Table 2-1. Intensity and acquisition distance

Time period	*Meteorological visibility Statute miles (kilometers)*	*Distance Statute miles (kilometers) **	*Nominal Intensity (candelas)*	*Obstruction Light*
		0.64 (1.0)	*32*	*CL-810*
Night	*1 (1.6)*	*1.18 (1.9)*	*2000*	*CL-864*
		1.5 (2.4)	*20,000*	*CL-865*
		1.4 (2.3)	*32*	*CL-810*
Night	*3 (4.8)*	*3.1 (5.0)*	*2000*	*CL-864*
		4.2 (6.8	*20,000*	*CL-864*
		1.5 (2.4)	*200,000*	*CL-856*
Day	*1 (1.6)*	*1.35 (2.2)*	*100,000*	*CL-857*
		1.0 (1.6km)	*20,000*	*CL-865*
		3.1 (5.0)	*200,000*	*CL-856*
Day	*3 (4.8)*	*2.65 (4.3)*	*100,000*	*CL-857*
		1.8 (2.9km)	*20,000*	*CL-865*
		Day to Night		
Twilight	*1 (1.6)*	*1.0 (1.6km) to 1.5 (2.4km)***	*20,000*	*CL-865*
	3 (4.8)	*1.8 (2.9km) to 4.2 (6.7km)***	*20,000*	*CL-865*

** For determination of acquisition distance refer to monograph method in Report No. FAA-RD-77-8 Visual Range: Concepts, Instrument Determination and Aviations Applications by C.A. Douglas and R.L. Booker.*
*** Distance depends on Northsky illuminance and is a range from day to night*

Information Note 4: Conclusion. Aircraft travelling at 165 knots (306 km/hr) or less should be able to see the obstruction lighting in sufficient time to avoid the structure by at least 610m horizontally under all conditions of operation, provided the pilot is operating in accordance with the CARs. Aircraft travelling between 165 knots (306 km/hr) and 250 knots (463km/hr) should be able to see the obstruction lighting unless the weather deteriorates to 1 statute mile (1.6 km) visibility at night during which time period 20,000cd would be required to see the lights at 1.5 statute miles (2.4 km). This intensity of 20,000cd if operated in 3 statute mile visibility could generate a residential annoyance factor. In addition, aircraft in these speed ranges can normally be expected to operate under instrument flight rules (IFR) at night when the visibility is 1 statute mile (1.6 km).

2.2 Shielding

(1) The principle of shielding is applied in a way that a dominant permanent building, structure or object which is marked or lighted, or both, obviates the need for marking or lighting other buildings, structures or objects in the immediate surrounding area, which might otherwise be treated as individual obstructions.

(2) More specifically, the principle of shielding is applied if the marking or lighting, or both, of a dominant permanent building, structure or object is assessed by the Transport Canada regional office as providing sufficient warning to aircraft that, in avoiding the dominant obstruction, they will also avoid the unmarked or unlighted obstructions in the immediate surrounding area without risk of collision.

(3) Where two similar objects of equal height are situated adjacent to each other, as shown in Figure 2-1, one of the two objects may be considered as shielded, provided the separations listed in Table 2-1 are not exceeded.

Table 2-2: Separation between Shielded Objects

Height of Objects AGL (metres)	Maximum Separation (metres)
$30 < x \leq 75$ ~~30 to 75~~	15
$75 < x \leq 120$ ~~76 to 122~~	23
$120 < x \leq 200$ ~~123 to 198~~	30
$200 < x \leq 290$ ~~199 to 290~~	45

290 < x ~~291 and higher~~	60

(4) A narrow obstruction may be considered as shielded when it is situated with respect to a large obstruction so that an aircraft, whose flight path would avoid the large obstruction would, as a result, also avoid the narrow one.

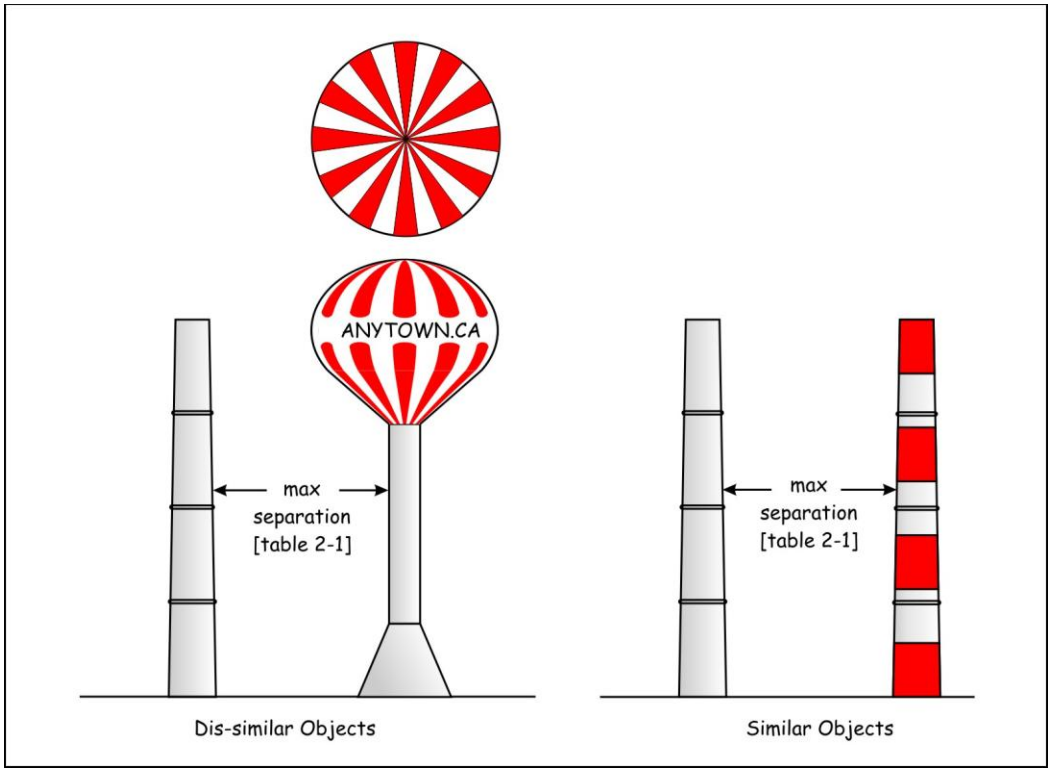

Figure 2-1: Adjacent Structures

(5) **Adjacent Catenaries**

(a) A catenary across a recognized VFR route does not require marking or lighting where it is shielded by a ~~larger object such as a bridge or~~ a higher catenary.

(b) A catenary segment may be considered as shielded when it is situated within 300 m ~~600m~~ of the marked catenary of the dominant obstruction so that it remains below a sloping down surface at a gradient of 5% projected from the marked catenary as shown in Figure 2-2.

(c) If the second catenary is above the gradient, this span may not be considered as shielded and is marked or lighted, or both, in accordance with this Standard.

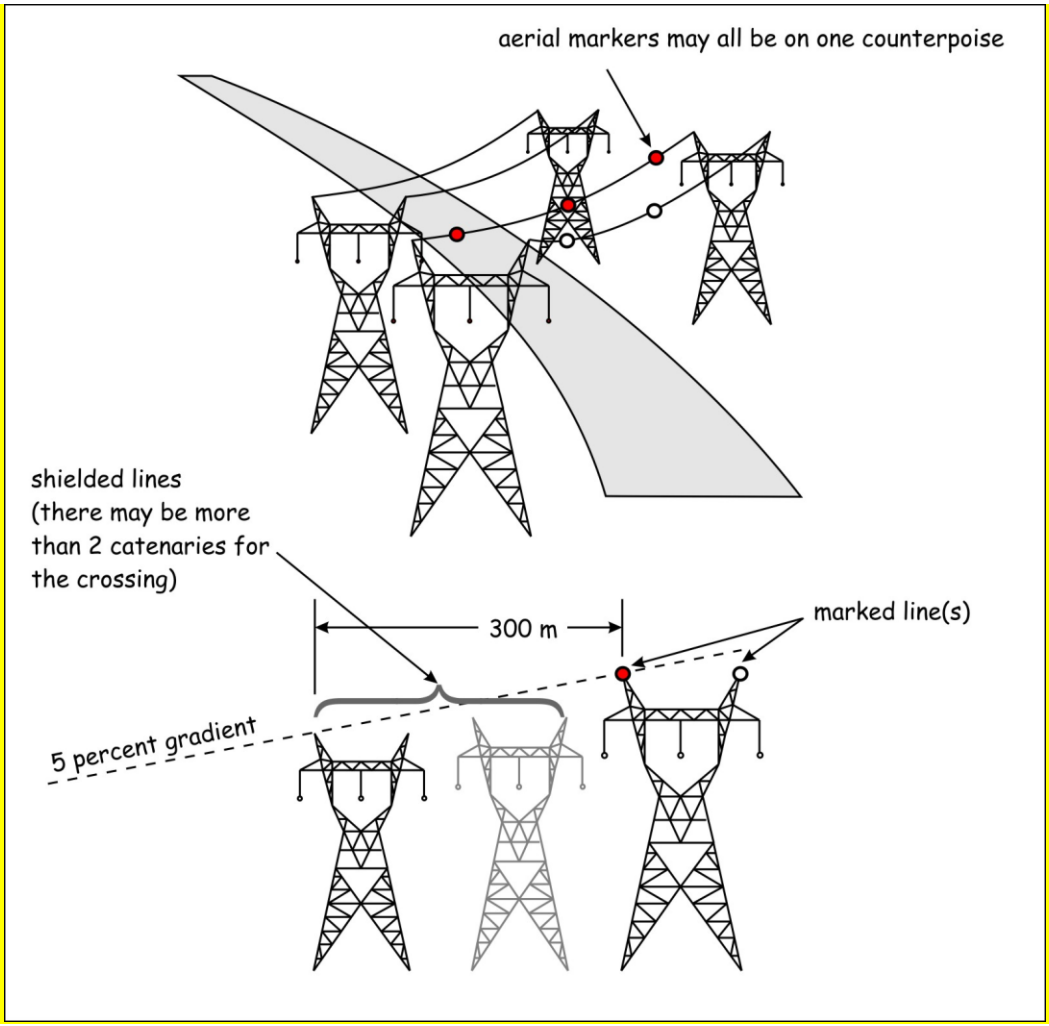

Figure 2-2: Shielding of cable spans

(6) Complex Objects

(a) Where it is not possible to apply a uniform standard to a cluster of objects such as industrial plants, oil refineries, thermal generating stations, and similar structures, they shall be assessed by the Transport Canada regional office on an individual basis to determine whether or not to treat them as hazards to aviation safety or as an extended obstruction, taking into account the objects' location and height.

(b) When treated as an extended obstruction, sufficient marking or lighting, or both, are provided to ensure that the extent of the cluster is defined and visual warning is provided from any angle of aircraft approach.

2.3 Lighting Equipment

(1) **Conformance**

Information Note: As a basis of ensuring procurement of equipment meets the requirements of this Standard, the person having responsibility or control over the obstruction should obtain an attestation of conformance through an established 3rd Party testing laboratory meeting ISO/IEC Guide 17025, "General Requirements for the Competence of Testing and Testing Laboratories."

(2) **Combined Light Units**

Information Note: The requirements specified in this Standard are written with respect to the performance of obstruction lighting, without consideration of how they are actually designed. Manufacturers may supply light sources contained within a single fitting. For example, a combined CL-864 red flashing beacon with a CL-865 white flashing light, as may be used for a dual medium intensity, configuration "E" installation.

2.4 Environmental Evaluation

Information Note: The person having responsibility or control over an obstruction may be required to file an environmental evaluation with the appropriate authority having jurisdiction when seeking authorization for the use of the high intensity flashing white lighting system on structures located in residential neighbourhoods. ~~as defined by the applicable zoning law.~~

2.5 ~~1.2~~ Notification Responsibilities

(1) A person planning to erect or modify an obstruction, namely a building, structure or object, including a moored balloon or kite, either permanently or temporarily, contact the appropriate regional Transport Canada Civil Aviation office, as specified in Appendix A , at least 90 days prior to erection and provide the information on the planned obstruction, using the Aeronautical assessment form for obstruction marking and lighting as shown in Appendix C:

(2) If it appears that planned construction might create an obstruction to air navigation in the vicinity of a Department of National Defence (DND) aerodrome, the person having responsibility or control over the construction advise the appropriate DND authorities.

Information Note: Aerial cables over navigable waters: Persons planning to construct and or place a work, including an Aerial cable and any structures supporting the cable, should consider the requirements under the Navigation Protection Act (NPA). Under the NPA, all proposed works (including Aerial cables) in, on, over, through, across, or under a navigable water listed in the NPA Schedule, may be subject to review and authorization by Transport Canada (TC) Navigation Protection Program (NPP) Officials. Therefore, proponents of proposed works over scheduled waters need to contact their local TC NPP Office for more information on the process for the review and authorization. It should be noted that the NPA also includes a Minor Works Order. Should the proposed work in a scheduled waterway meet the criteria listed in the Order, the work may proceed without authorization under the Act.

(3) Any person planning to erect an object also provides information to NAVCANADA ~~Nav Canada~~, using the "Land Use Proposal Submission Form" (« Projet d'utilisation particulière d'un terrain ») which is available from the appropriate Transport Canada regional office. (See Appendix A)

~~**Information Note:** *Any person planning to erect an obstruction should also provide information to NAVCANADA Nav Canada, using the "Land Use Proposal Submission Form" (« Projet d'utilisation particulière d'un terrain ») which is available from the appropriate Transport Canada regional office. (See* Appendix A~~)

Information Note: Where possible, for objects such as broadcast antennae and wind farms, a sign identifying the owner of the object and providing contact information should be installed at the entrance gate or any other place as appropriate.

2.6 Correction of Lighting Failure

(1) Conspicuity of the obstacle is achieved only when all required marking and lighting is working. Partial equipment failures decrease the margin of safety. Any outage is corrected as soon as possible. Failure of a steady burning side or intermediate light is corrected as soon as possible, but notification is not required.

2.7 Light Failure Notification

(1) Failure or malfunction of lighting is reported immediately to the appropriate Flight Information Centre (FIC) so that a NOTAM can be issued. Failure of a steady burning CL-810 light is corrected as soon as possible, but notification is not required. Toll-free numbers for FIC are listed in Appendix A. The report should contain the following information:

(a) Name of persons or organizations reporting the light failure including any title, address, and telephone number.
(b) The type of structure.
(c) Location of structure (including latitude and longitude, if known, prominent structures, landmarks, etc.).
(d) Height of structure above ground level (AGL)/above mean sea level (AMSL), if known.
(e) An estimated return to service date.

Information note 1. When the primary lamp in a double CL-810 obstruction light fails, and the secondary lamp comes on, no report is required. However, when one of the lamps in the incandescent CL-864 flashing red beacon fails, it should be reported, as both lamps must be operating to provide the required photometrics.

Information note. 2. The sponsor is responsible for calling the nearest FIC to extend the outage ~~date~~ duration or to report ~~a~~ return to service ~~date~~.

2.8 Object Height Tolerance

Object height values contained in this Standard have a tolerance of [0, + 2%].

Information note. The purpose of the tolerance is to enable a transition from FAA height criteria.

Chapter 3 - Marking and Markers

3.1 Scope.

Chapter 3 governs marking requirements for obstructions to air navigation in order to make them conspicuous to pilots during daylight.

3.2 Paint Standards.

Where alternate sections of aviation orange and white, referred herein as "orange" and "white" paint markings, are required under this Standard to be displayed on a building, structure or object, the colours of paint markings shall be in accordance with United States Federal Standard FED–STD–595B, for colours identified as:

(a) orange, number 12197; and
(b) white, number 17875.

3.3 Surfaces Not Requiring Paint

(1) Except as otherwise provided for in Chapter 3, ladders, decks, and walkways of steel towers and similar structures are not to be painted, if a painted surface presents a potential hazard to maintenance personnel.

(2) Subject to paragraph (3), paint may be omitted from precision or critical surfaces, if it would have an adverse effect on the transmission or radiation characteristics of a signal.

(3) Where markings are omitted under paragraph (1) or (2), the overall marking effect of the structure shall not be reduced to the point of compromising the visibility criteria of section 2.1.

3.4 Use of Plastic Wrapping

In the case of poles, where the use of paint is impractical, a wrapping of plastic or other weather resistant material, in the required colours and dimensions, may be applied instead of painting provided that the colour of the wrapping corresponds as close as possible to that required for a painted marking.

3.5 Paint Patterns

Information Note: The following patterns of painting are dependent upon the size and shape of the structure.

(1) **Solid Pattern.** A structure is coloured solid orange, if the structure has both horizontal and vertical dimensions not exceeding 3.2 m.

(2) **Checkerboard Pattern**

(a) Subject to paragraph (c), alternating rectangles of aviation orange and white are displayed on the following types of structure
  (i) storage tanks for water, gas, grain, and similar tanks,
  (ii) buildings,
  (iii) structures that both:
    (A) appear broad from a side view, that are 3.2 m or more across horizontally, and
    (B) have a horizontal dimension that is equal to or greater than the vertical dimension.

(b) Checkerboard patterns have the following characteristics [refer to Figure 3-1]:
  (i) for structures having horizontal and vertical dimensions, both greater than 3.2 m, the sides of the checkerboard pattern measure not less than 1.5 m nor more than 6 m,
  (ii) for structures having horizontal or vertical dimensions, both less than 4.5 m, the sides of the checkerboard pattern may be less than 1.5 m, but not less than 1 m,
  (iii) the rectangles of the pattern are as nearly square as possible, and
  (iv) corners are coloured orange.

(c) The following exceptions apply to the marking requirements set out in this paragraph:
  (i) storage tanks not suitable for a checkerboard pattern are coloured with alternating bands of

aviation orange and white or a limited checkerboard pattern applied to the upper one-third of the structure, and

(ii) the skeletal framework of certain water, gas, and grain storage tanks may be excluded, as a result of a risk evaluation, from the checkerboard pattern, where the main structure of the storage tank is large enough that its checkerboard pattern adequately suits the purpose of day marking.

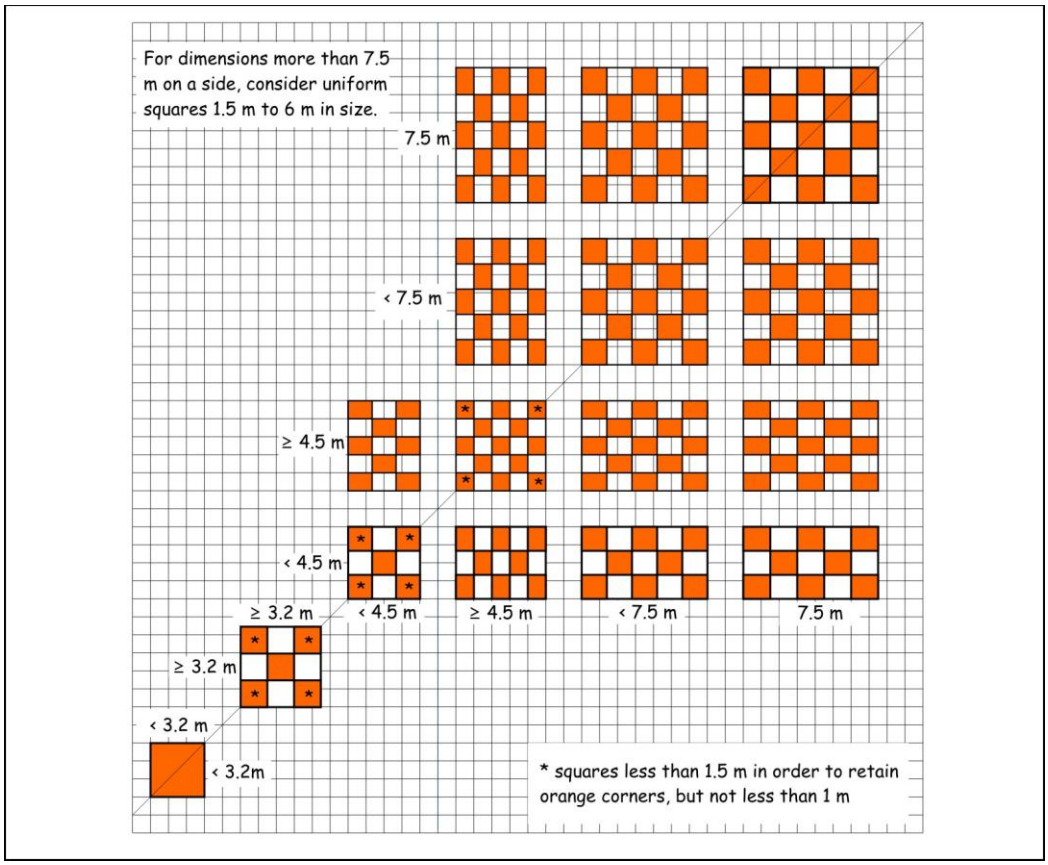

Figure 3-1: Day Marking - Checkerboard Pattern

(3) **Colour Bands**

(a) Subject to paragraph (4), alternate bands of orange and white are displayed on the following types of structure:

(i) communications towers and supporting structures of overhead transmission lines,

(ii) poles,

(iii) chimneys,

(iv) skeletal framework of storage tanks and similar structures,

(v) wind turbine towers and rotor blades, including the nacelle or generator housing,

(vi) cables, conduits, and materials attached to the face of a tower, whether at time of construction or when later added to the structure, and

(vii) structures that appear narrow from a side view, that are 3.2 m or more across horizontally, and the horizontal dimension is less than the vertical dimension.

(b) Bands applied to structures of any height in excess of 3.2 m [refer to Figure 3-2]:

(i) are approximately equal in width and to a tolerance of ± 10 percent,

(ii) are not more than 30 m wide,

(iii) are coloured orange for the top and bottom bands,

(iv) have an odd number of bands on the structure, and

(v) are in accordance with Table 3-1, except that for each additional 60 m or fraction thereof, one (1) additional orange and one (1) additional white band are added.

Table 3-1: Structure Height to Number of Bands Requirement

Structure height (AGL)		Number of Bands
Greater than (metres)	Not exceeding (metres)	
0	3.2	solid
3.2	210	7
210	270	9
270	330	11
330	390	13
390	450	15
450	510	17
510	570	19
570	630	21

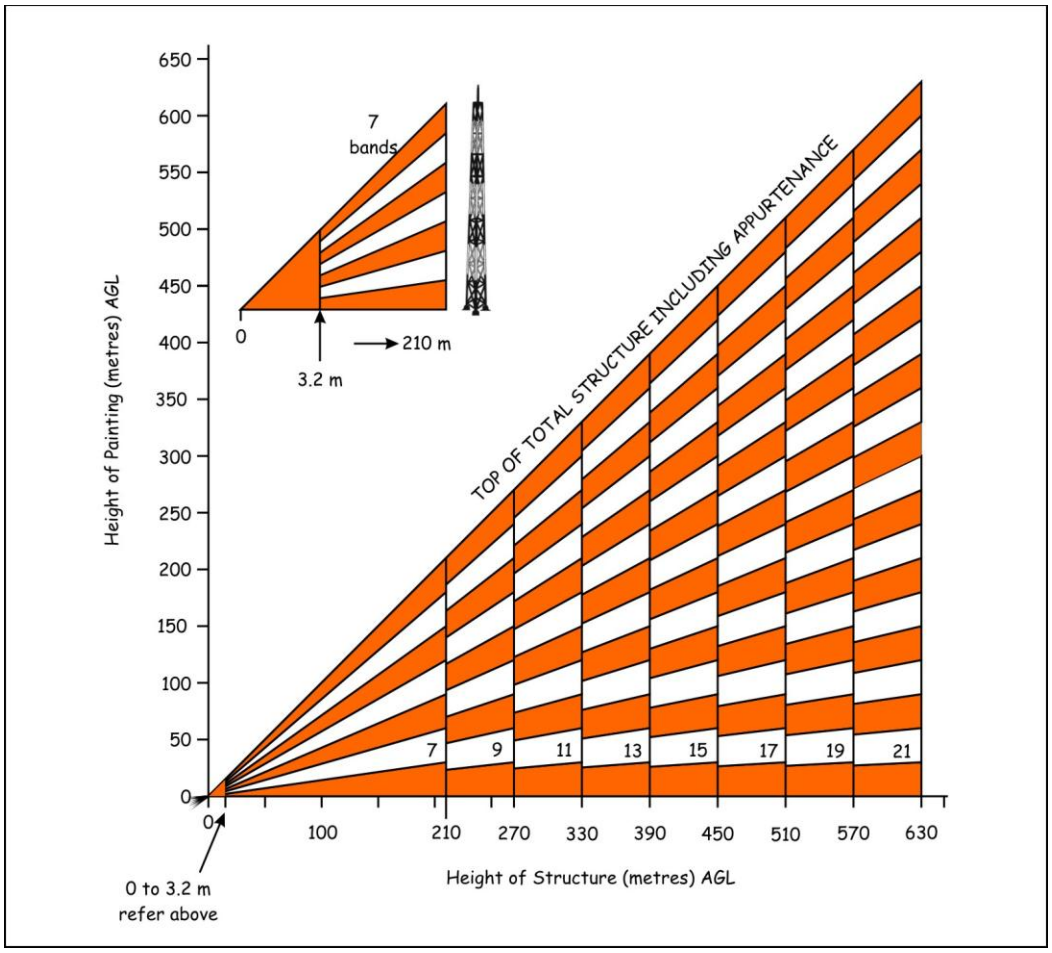

Figure 3-2: Day Marking - Banded Pattern

(4) **Structures With a Cover or Roof.** If a structure referred to in paragraph (3) has a cover or roof whose profile in the line of sight of approaching aircraft is less than 1.5 m, the highest orange band is continued to cover the entire top of the structure. It is acceptable to have the roof made of a solid orange provided that the structure below has a checkerboard pattern.

(5) **Skeletal Structures Atop Buildings.** Where a flagpole, skeletal structure, or similar object is erected on top of

a building:

(a) the combined height of the object and the building determines whether marking is required; however, only the height of the object determines the width of the colour bands; and

(b) if the building is required to have a checkerboard pattern of marking, the object and its height are considered separately for banding determination.

(6) **Appurtenances.** If a tower or similar skeletal structure is required to have banded marking and it also has an appurtenance of more than 12 m, then the combined height of the appurtenance plus that of the main structure determine the width of the banding.

(7) **Partial Marking .** If marking is required for only a portion of a structure because of shielding by other objects or terrain:

(a) the width of the bands is determined by the overall height of the structure;

(b) a minimum of three bands are displayed on the upper portion of the structure; and

(c) in the case of cylindrical storage tanks as shown in Figure 3-2, the checkerboard marking may be applied to the top ½ to 2/3 of the tank.

(8) **Teardrop Pattern.** Spherical water storage tanks with a single circular standpipe support may be marked in a teardrop-striped pattern having the following characteristics:

(a) alternate stripes of aviation orange and white are displayed on the tank, as shown in Figure 3-3;

(b) the stripes extend from the top centre of the tank to its supporting standpipe; and

(c) the width of the stripes are nearly as equal as possible and the width at the greatest girth of the tank is not to be less than 1.5 m nor more than 6 m.

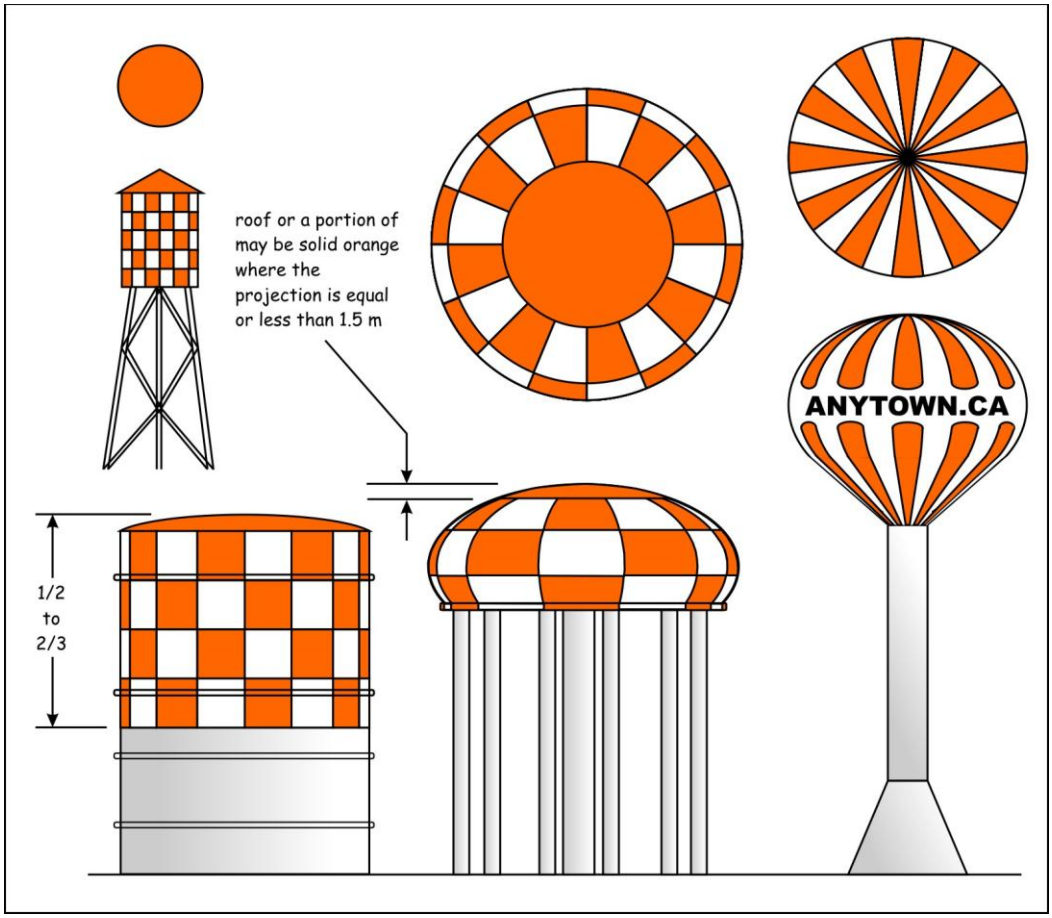

Figure 3-3: Storage Tank Marking

(9) **Community Names.** If it is desirable to paint the name of the community on the side of a tank, the marking pattern may be broken for a height of not more than 1.0 m to serve this purpose.

3.6 Flag Markers

(1) **Application.** One or several flags may be used as markers instead of paint to indicate the presence of certain structures or objects when it is technically impractical to use spherical markers or painting.

Information Note: Some examples of structures or objects where flags may be used are temporary construction equipment, cranes, derricks, oil and other drilling rigs.

(2) **Characteristics.** Flags used as markers under paragraph (1) have the following characteristics:

(a) Minimum Size - each side of a flag is at least 0.6 m in length;

(b) Colour Patterns - they are coloured as follows:

(i) if solid, the colour is orange,

(ii) if orange and white colours are used, two triangular sections, one aviation orange and the other white, are arranged to form a rectangle, or

(iii) a checkerboard pattern of aviation orange and white squares of 0.3 m to a side, is used if the flags are 0.9 m or larger;

(c) Shape - they are rectangular in shape and have stiffeners to keep it from drooping in calm wind; and

(d) Manner of Display - they are displayed as follows:

(i) around, on top, or along the highest edge of the obstruction,

(ii) when used to mark extensive or closely grouped obstructions, the flags are displayed approximately 15 m apart, and

(iii) the flag stakes are to be of such strength and height that they are able to support the flags above all surrounding ground, structures, or objects of natural growth, as the case may be.

3.7 Omission of Marking with Use of Lighting

A high or medium intensity white flashing lighting system may be used in place of marking if the following conditions are met:

(a) the lighting system is operated 24 hours a day; and

(b) in the case of a medium intensity lighting system, the system:

(i) is operated 24 hours per day, and

(ii) the structure on which it is used is 150 m AGL or less.

3.8 Crane Marking

Where day protection is to be provided, cranes are marked with banding according to Table 3-1. Figure 3-4 illustrates application of 7 bands of marking for a horizontal jib crane, a gantry crane and a temporary crane affixed to an existing structure. In the case of a horizontal jib crane, adjustment of dimensions may be necessary to accommodate the point at which the vertical support crosses the jib.

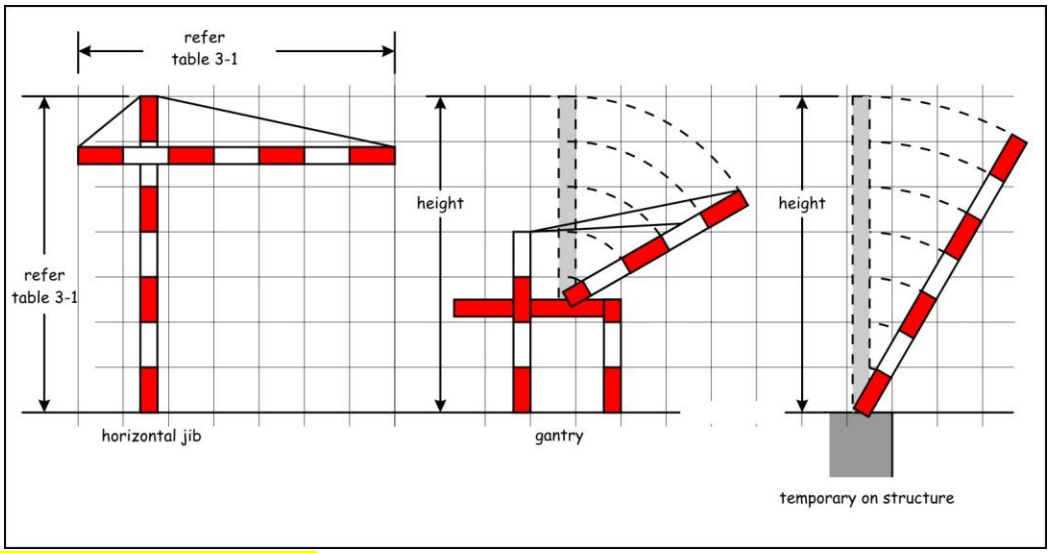

Figure 3-4. Crane Marking

Chapter 4 - Lighting, General

4.1 Scope

Chapter 4 governs lighting requirements for obstructions to air navigation in order to make them conspicuous to pilots during night time, except as otherwise provided for in this Standard. ~~It also governs the marking requirements of catenary wires, catenary support structures, moored balloons and kites, for daytime.~~

Information Note: Lighting is used to warn pilots of a potential collision during night time operations. If the lighting is of sufficient intensity, it may also serve to give warning during daytime operations and may be approved, by way of a risk evaluation, in lieu of other means of day marking. Criteria for lighting structures, as a result of a risk evaluation, can vary depending on terrain features, weather patterns, and geographic location.

4.2 Lighting Systems

(1) Configurations. Obstruction lighting is displayed on a building, structure or object in one of six configurations, as shown in name+ 4-1 and listed in Table 4-2.

Information Note: The following is a listing of light units required under this Standard. Chapter 13 provides detailed characteristics of these light units. Appendix B contains the governing electrotechnical requirements and quality assurance testing.

Table 4-1: Light Units

Type	Intensity	Colour	Signal	Flash Rate (fpm)
CL-810	Low	red	fixed	n/a
CL-864	Medium	red	flashing	20-40
CL-865	Medium	white	flashing	40
CL-866, Catenary	Medium	white	flashing	60
CL-885, Catenary	Medium	red	flashing	60
CL-856	High	white	flashing	40
CL-857, Catenary	High	white	flashing	60

Note 1: *In certain cases, some of these lights are supplied as a combined unit (e.g. CL-864/CL-865)*
Note 2: *fpm = flashes per minute*

Information note. The listing above for "catenary" applies to lighting of the support structures. Catenary wire lights meet the photometric requirements for CL-810.

Table 4-2: Lighting Configurations

Configuration	Lighting
A	CL-810 low and CL-864 medium intensity red lighting system
A'	Alternative red, light reduction to reduce bird fatalities
B	CL-856 white high intensity (without appurtenance lighting)
C	CL-856 white high intensity (with CL-865 appurtenance lighting)
D	CL-865 white medium intensity
E	Dual CL-810/CL-864 red with CL-865 white medium intensity lighting
F	Dual CL-810/CL-864 red with CL-856 white high intensity lighting

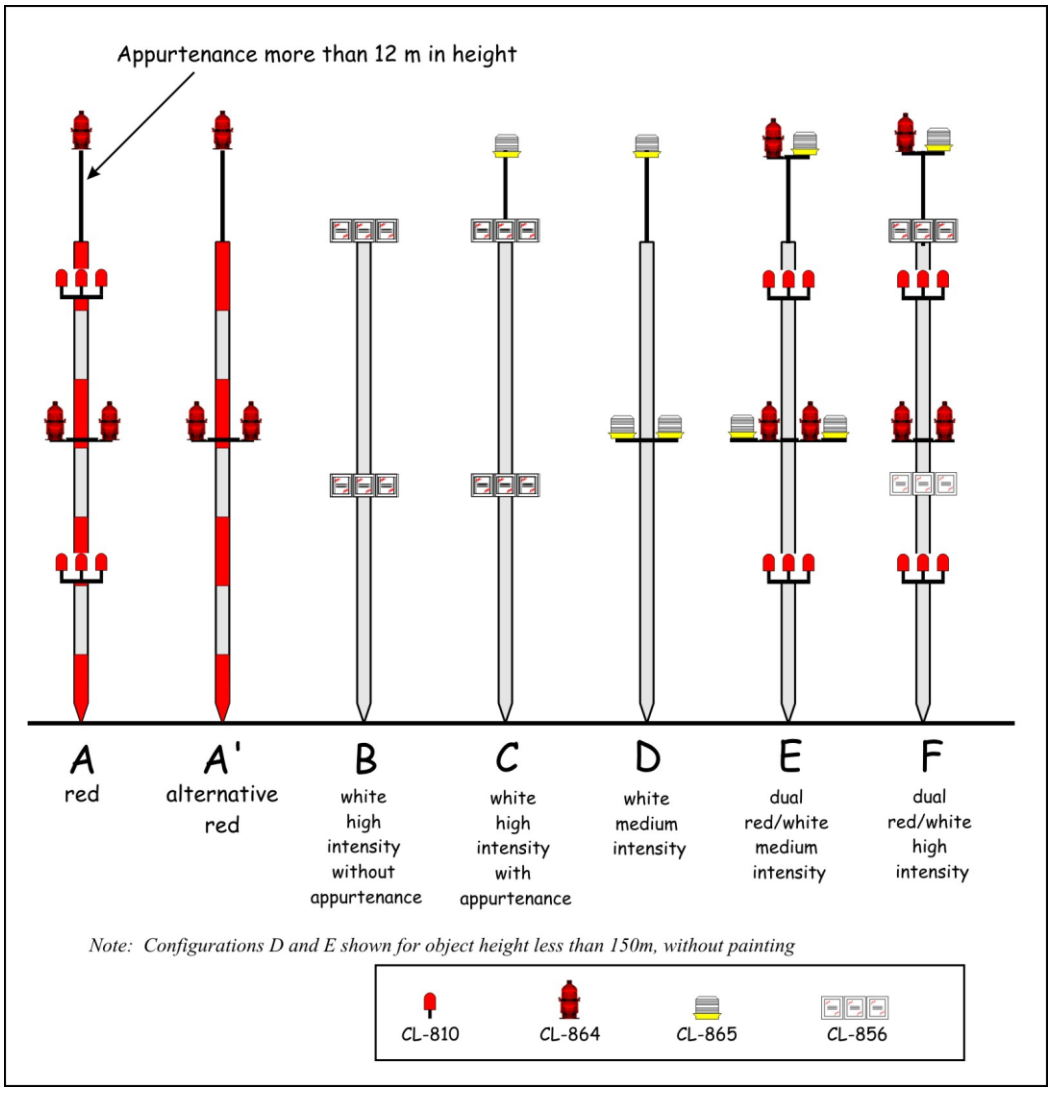

Figure 4-1: Configurations of Lighting on Skeletal Structures

(2) Red Lighting Systems. A red obstruction lighting system consists of CL-810 low intensity steady burning aviation red lights and CL-864 medium intensity red flashing aviation beacons.

(3) CL-865 Medium Intensity White Flashing Lighting Systems

(a) A medium intensity white flashing lighting system consists of CL-865 medium intensity flashing white lights used during day/twilight with automatically selected reduced intensity for night time operation.

(b) When the system is used on a building, structure or object 150 m AGL or less in height, the marking requirements may be omitted.

Information Note 1: No exemption applies from the requirement to display markings on a building, structure or object exceeding 150 m AGL that has a CL-865 medium intensity white flashing lighting system.

Information Note 2: This lighting system, except for the rotating type CL-865, is not normally recommended on buildings, structures or objects 60 m AGL or less.

(4) High Intensity White Flashing Lighting Systems

(a) A high intensity white flashing lighting system consists of CL-856 and CL-857 high intensity flashing white lights used during daytime with automatically selected reduced intensities for twilight and night time operations.

(b) When the system is in use, the markings and the other lights required to be displayed on the building, structure or object may be omitted.

Information Note: This lighting system should not be used on buildings, structures or objects 150 m AGL or less, unless a risk evaluation shows otherwise.

(5) **Dual Lighting Installation**

(a) A dual lighting system consists of red lights for night time use and high or medium intensity flashing white lights for daytime and twilight use.

(b) When a dual lighting system incorporates medium flashing intensity lights on a building, structure or object 150 m or less in height, or high intensity flashing white lights on a building, structure or object of any height, the marking and the other lighting requirements may be omitted.

~~*Information Note: When a building, structure or object is located in an urban area where there are numerous other white lights (e.g., streetlights, etc.), red obstruction lights with painting or a medium intensity dual system is recommended.*~~

~~**4.3 *Floodlighting***~~

~~(1) A chimney, church steeple or similar obstruction not exceeding 150 m in height, may be floodlighted by three or more fixed search light projectors installed at equidistant points around the base of the obstruction.~~

~~(2) Where floodlighting is used for an obstruction referred to in paragraph (1), the top 1/3 of the structure shall be provided with at least 30 lux of illumination as directed from the object horizontally to an approaching pilot, assuming diffuse reflection from the object.~~

4.3 Obstruction Lights During Construction

(1) As the height of a building, structure or object under construction progressively exceeds each level at which permanent obstruction lights would be required, two or more temporary medium intensity white flashing lights are installed at that level.

(2) Temporary lighting required under paragraph (1) is operated 24 hours a day until all permanent lights required under this Standard are in operation.

(3) If practical, permanent obstruction lighting required under this Standard shall be installed and operated at each level as construction progresses.

(4) The lights shall be positioned to ensure that a pilot has an unobstructed view from any angle of approach of at least one light at each level.

4.4 Temporary Construction Equipment Lighting

Information Note: Since there is such a variance in construction cranes, derricks, oil and other drilling rigs, each case should be assessed individually. However, in principle, lights should be installed according to the standards given herein, as they would apply to permanent structures.

4.5 Groups of Obstructions

(1) When individual buildings, structures or objects within a group of obstructions are not the same height and are spaced more than 45 m apart, the prominent building, structure or object within the group is lighted in accordance with the standards for individual obstructions of a corresponding height.

(2) If an outer building or structure is shorter than the prominent one, it is lighted in accordance with the requirements for individual obstructions of a corresponding height.

(3) Light units required under this section are placed to ensure that the light is visible to a pilot approaching from any direction.

(4) In addition to the requirement set out in paragraph (3), at least one flashing beacon is installed at the top of a prominent centre obstruction or on a special tower located near the centre of the group.

(5) If there is no prominent centre obstruction, a risk evaluation shall be performed to assess the location of the applicable beacons.

4.6 Glare from Flashing Obstruction Lights

(1) Where obstruction lighting is likely to distract operators of aircraft, railway trains, surface vessels, and other vehicles, or if the lighting is in a congested residential area, a suitable shield is installed on the appropriate lights to minimize the glare effects of the light.

(2) The application of such shielding shall not diminish the required performance of the light as specified in Chapter 13 of this Standard for obstruction identification to pilots.

(3) Shielding applied to the exterior of the light unit is suitable for environmental conditions such as snow, ice and frost cover, so that the light output is not degraded from that required by this Standard.

(4) In the proximity of navigable waterways or along coastal regions, the installation of an obstruction lighting system is coordinated with marine authorities by the owner or operator of the obstruction in order to avoid interference with marine navigation.

4.7 Monitoring of Obstruction Lights

The objective of monitoring is to enable the owner to maintain the lighting system in operation without failure. The occurrence of light failure is detected so that a NOTAM can be issued and repair action undertaken in a timely fashion.

(1) The owner of a structure with a flashing obstruction light system is responsible:

(a) to know there is occurrence of any failure, by observation once every 24 hours, either visually or through observation of a remote indicator designed to show failure of such lighting regardless of position or colour. For medium and high intensity lighting and dual lighting systems, observation is made for at least the day and night modes of operation.

(b) to have a documented program of at least annual inspection of all automatic or mechanical control devices, indicators, and alarm systems associated with the structure lighting to ensure that the such apparatus is functioning properly.

(2) Is exempt from paragraph 4.7(1)(b) where the alarm system has self-diagnostic features to confirm the communication link and operational status of the monitoring system itself at least once every 24 hours.

(3) Where it is not possible to do observation either visually or through means of a remote indicator, the objective of monitoring is accomplished through provision of lamps having a rated life of more than one year of operation and establishment of a documented program of at least annual inspection.

(4) For each structure, a log is maintained showing the history of observations, inspections, failures, repairs, and relamping, as applicable for the method of monitoring used.

(5) The owner of the structure advises NAV CANADA, as soon as possible, of any obstruction light failure so that a NOTAM can be initiated in accordance with paragraph 2.7(1).

Information note: Each flashing light system, in accordance with Appendix B, is to have a controller which gives indication of the status of both the flashing lights and any associated steady burning lights. The controller has provision to permit connection to a remote alarm indicator (supplied by others or as an option)

Figure 4-2 illustrates a variety of methods for monitoring. Method (a) is the use of an alarm system for failure indication only. Method (b) determines the status of all the lights in a 24 hour period, which may be considered as a form of self-diagnosis.

Since it is the responsibility of the owner to know of a failure, Method (b) may be chosen over Method (a) in consideration of reliability. If the failure alarm is given only at the time of occurrence, will the communication link and overall monitoring system be functioning properly to transmit the alarm to the owner??

Method (c) is an instance for which it is not possible to provide a communications link. For this method the objective of monitoring is accomplished through the use of lamps having a rated life of more than one year of operation combined with at least annual inspection and relamping. In the case of LED sources the owner may choose to not re-lamp based on experience; annual inspection, however, should still take place.

In the case of Method (d), monitoring would not normally be required as it is not a flashing light system. However, inspection and relamping should be undertaken as in Method (c).

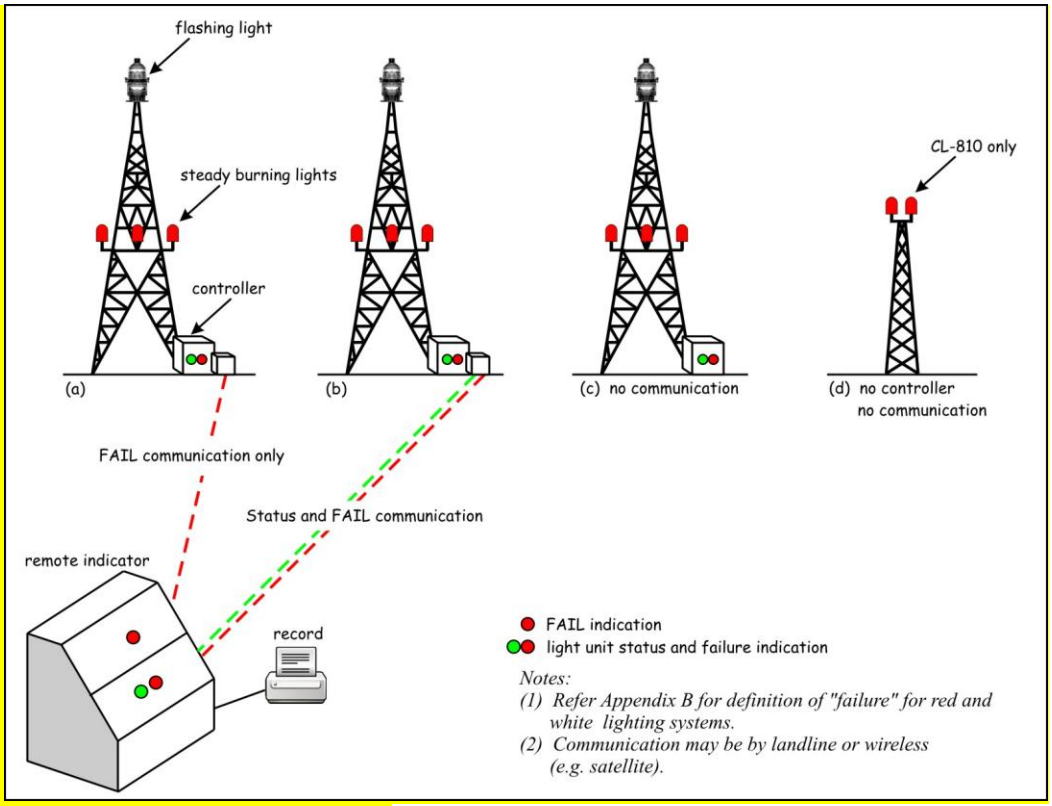

Figure 4-2. Methods of monitoring

~~***4.7 Monitoring of Obstruction Lights***~~

~~(1) An obstruction lighting system required under Chapter 4 is monitored by visual or automatic means.~~

~~(2) On a system without automatic monitoring, the obstruction lighting is visually inspected in all operating intensities at least once every 24 hours.~~

~~(3) If the lighting system of a building, structure or object is not readily accessible for visual observation, a properly maintained automatic monitor is used.~~

~~(4) The monitor referred to in paragraph (3) is designed to register the malfunction of any light on the obstruction regardless of its position or colour.~~
~~(5) When using a remote monitoring device, the communication status of the device and operational status of the lighting system is confirmed at least once every 24 hours.~~
~~(6) The monitor display is located in an area occupied by responsible personnel where the status of the lighting can be noted at least once every 24 hours.~~
~~(7) The owner or operator of the obstruction lighting system advises NAV CANADA, as soon as possible, of any obstruction lighting failures so that an appropriate NOTAM action can be initiated.~~

4.8 Placement Factors

(1) The height of a building, structure or object above ground (AGL) is used to determine the number of light levels required to be installed as part of a lighting system.

(2) The height of light levels required to be installed may be adjusted slightly, but not to exceed 3 m, when necessary to accommodate guy wires and personnel who replace or repair light fixtures.

(3) Except for catenary support structures, the following factors are considered when determining the placement of obstruction lights on a building, structure or object:

(a) for a red obstruction lighting system or a medium intensity white flashing lighting system, the overall height of the structure including all appurtenances such as rods, antennae, obstruction lights and similar objects, determine the number of light levels;

(b) for a high intensity white flashing lighting system,

(i) the overall height of the main structure excluding all appurtenances is used to determine the number of light levels, and

(ii) if required, a CL-865 medium intensity flashing light is displayed on the highest portion of any antenna or other appurtenance supported by the main structure; and

(c) for a dual obstruction lighting system, the determination of the number of light levels is in conformity with the pertinent requirements for white and red lighting systems.

(4) The elevation of the tops of adjacent buildings or structures in congested areas is used as the equivalent of ground level to determine the proper number of light levels required.

(5) If an adjacent building, structure or object shields any light, horizontal placement of the lights is adjusted or additional lights are mounted on that object to retain or contribute to the definition of the obstruction.

4.9 Ice Protectors

(1) Where icing is likely to occur, metal grates or similar protective means are installed directly over each light unit required under this Standard to be installed on a building structure or object to prevent falling ice or accumulations from damaging the light units.

(2) The protective means are of a design and manner of placement such that the required photometric output of the fixtures is not affected.

Chapter 5 - Red Obstruction Lighting System, Configuration "A"

5.1 Scope

Chapter 5 governs obstruction lighting that uses a configuration "A" lighting system.

Information note: Red Obstruction lights are used to increase conspicuity during nighttime. Daytime and twilight marking is required. Recommendations on lighting structures can vary depending on terrain features, weather patterns, geographic location, and in the case of wind turbines, number of structures and overall layout of design.

5.2 System Requirements

(1) **General**

(a) A configuration "A" red obstruction lighting system, as shown in Figure 5-1, consists of one or several, ~~as required under Chapter 5~~, CL-864 red flashing beacons or CL-810 steady burning red lights, or a combination thereof.

(b) When red lighting alone is used for night protection, no exemption to markings for day protection required under this Standard is allowed.

(c) Refer chapter 13 for control of red lighting systems.\

Information Note: The CL-810 comes in two forms; a single unit [one lamp and one globe] and a double unit [two lamps and two globes].

(2) Single CL-810 Obstruction Light Units. Where more than one obstruction light is required either vertically or horizontally, or where maintenance can be accomplished within a reasonable period of time, single unit CL-810 lights may be used as follows:

(a) Top Level atop structures such as airport ILS buildings and long horizontal structures such as perimeter fences and building roof outlines; or

(b) Intermediate Level at intermediate levels on skeletal or solid structures when more than one level of lights is required to be installed and there are two or more single units per level.

(3) Double Obstruction Light Units. Subject to paragraph (2), when used as a top light or in areas or locations where the failure of a single unit could cause an obstruction to be totally unlighted, double unit CL-810 lights are installed at each end of a row of single unit obstruction lights, and more specifically as follows:

(a) Top Level on a structure, building or object 45 m AGL or less, one or more double unit lights operating simultaneously are installed at the highest point;

(b) Intermediate levels,

(i) double unit lights are installed when a malfunction of a single unit light could create an unsafe condition and in remote areas where maintenance cannot be performed within a reasonable time, and

(ii) both lamps of the double unit operate simultaneously or a transfer relay is used to switch to the inactive lamp should the active lamp fail; and

(c) Lowest Level at the lowest level of a building, structure or object,

(i) light units may be installed at a higher elevation than standard if the surrounding terrain, trees or any adjacent buildings would obscure the lights, or

(ii) in certain exceptional instances, as determined by a risk evaluation, the lighting otherwise required for the lowest level may be omitted.

~~(3) **Single CL-810 Obstruction Light Units**~~

~~Where more than one obstruction light is required either vertically or horizontally, or where maintenance can be accomplished within a reasonable period of time, single unit CL-810 lights may be used as follows:~~

~~*(a)* Top Level atop structures such as airport ILS buildings and long horizontal structures such as perimeter fences and building roof outlines; or~~

~~*(b)* Intermediate Level at intermediate levels on skeletal or solid structures when more than one level of lights is required to be installed and there are two or more single units per level.~~

(4) Flashing Display. When one or more levels of lights are comprised of CL-864 flashing beacons, the lights ~~shall~~ flash simultaneously.

(5) Equivalent Method of Displaying Obstruction Lights. Provided that approval is obtained following the result of a risk evaluation, lights may be placed on poles equal to the height of the building, structure or object required to be lighted, and may be installed on or adjacent to such building, structure or object.

5.3 Poles, Radio and Television Towers and Similar Skeletal Structures

The following requirements apply to radio and television towers, supporting structures for overhead transmission lines, and similar structures. Refer to Figures 5-1 and 5-2.

(1) On the topmost part of a structure:

(a) 45 m AGL or less, two or more CL-810 steady burning lights are installed in a manner to ensure an unobstructed view of one or more lights by a pilot; or

(b) exceeding 45 m AGL, at least one CL-864 red flashing beacon is installed in a manner to ensure an unobstructed view of one or more lights by a pilot.

(2) On the intermediate levels of a structure:

(a) the number of levels of lights is in accordance with Figures 5-1;

(b) the number of lights at each level is determined by the shape and height of the structure;

(c) the lights are installed so as to provide an unobstructed view of at least one light by a pilot from any angle of approach;

(d) where CL-810 steady burning red lights are installed on:

(i) a structure 105 m AGL or less, two or more steady burning red lights are installed on diagonally or diametrically opposite positions, and

(ii) a triangular shaped structure 105 m AGL or less:

(A) two red light units, single or double, are installed, provided that at least one can be viewed unobstructed by a pilot from any angle of approach, or

(B) where the requirement specified in clause (A) is impractical, three red light units are installed, one on each apex of the triangular cross-section, or

(iii) a structure exceeding 105 m AGL, a CL-810 steady burning red light is installed on each outside corner at each level; and

~~(e) where a CL-864 flashing red beacon is used on a structure exceeding 105 m AGL, the red flashing beacon is properly installed within the structure, except that if the structural members impair the viewing of the beacon, two flashing red beacons are installed on the outside of diagonally or diametrically opposite positions at each level.~~

(e) Where CL-864 flashing red beacons are used on a structure exceeding 105 m AGL the CL-864 lights at intermediate levels are installed on the outside of the tower structure on diagonally or diametrically opposite positions at each level.

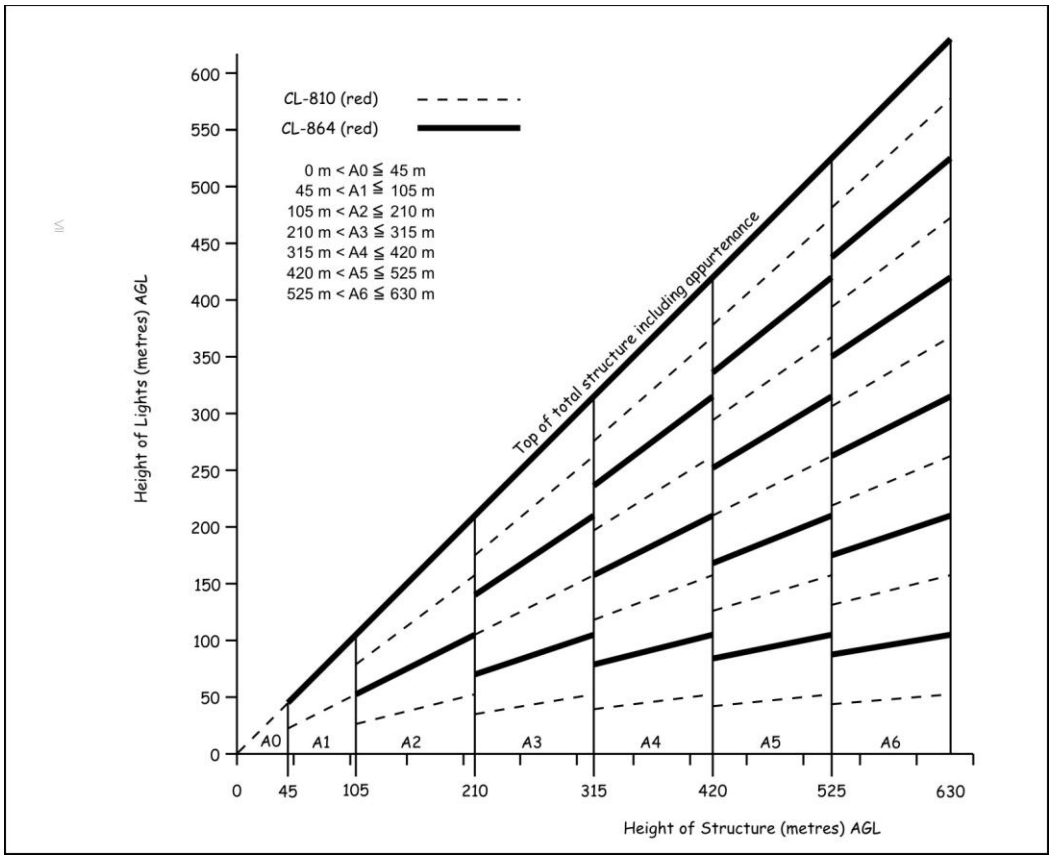

Figure 5-1: Configuration A red lighting installation

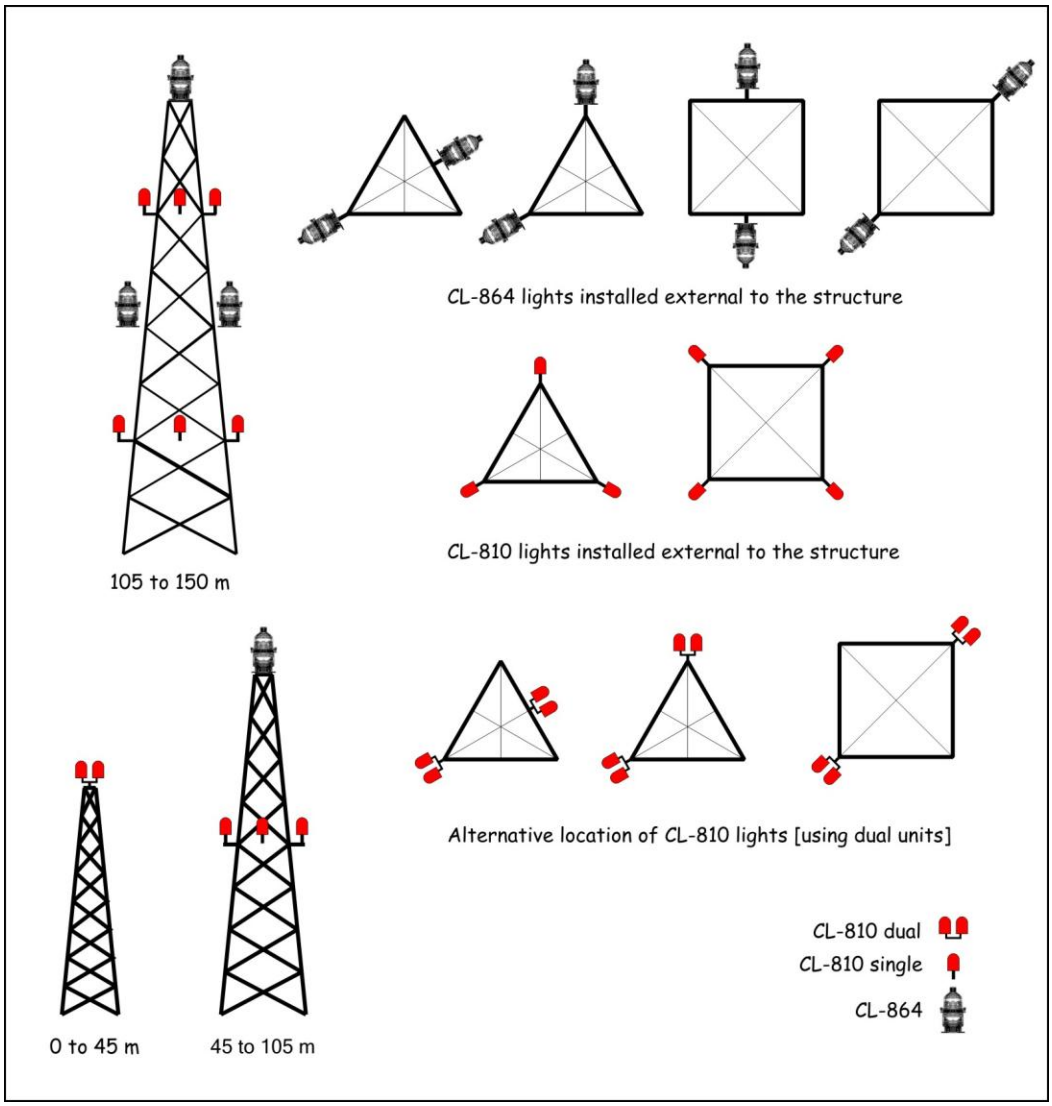

Figure 5-2: CL-810 and CL-864 lights on towers

(3) Appurtenances. Where a building, structure or object required to be lighted includes an appurtenance such as a rod, antenna, or similar extension, a topmost light is installed above the main part of the building, structure or object in accordance with the provisions of this paragraph.

(a) Where the appurtenance is 12 m or less in height and:

(i) is incapable of supporting a red flashing beacon, the beacon may be placed at the base of the appurtenance, or

(ii) if the mounting location does not allow unobstructed viewing of the beacon by a pilot from any angle of approach, additional beacons are added.

(b) Where the appurtenance exceeds 12 m in height and:

(i) is incapable of supporting a red flashing beacon, a supporting mast with one or more beacons is installed adjacent to the appurtenance, and

(ii) the adjacent installation of (i) does not exceed the height of the appurtenance and is within 12 m of the tip of the appurtenance to allow the pilot an unobstructed view of at least one beacon, from any angle of approach.

Information Note: The primary focus of "appurtenance" is to enable installation of a short rod, antenna or similar extension of less than 12 m in height without lighting. It is not intended that the feature of "appurtenance" would

involve extensions that are significantly in excess of 12 m. In such instance, the extension is to be considered as adding to the height of the main object.

5.4 Alternative Configuration A to reduce bird fatalities

(1) An alternative Configuration A is applied for purpose of reducing bird fatalities and consists of only CL-864 lights as shown in Figure 5-3 for objects heights of more than 105 m.
(2) For A1 heights of more than 45 m to 105 m, the CL-810 lights are made to flash at the same rate as the top mounted CL-864 light.

Information note: The alternate Configuration A is only applicable to Towers and Similar Skeletal Structures.

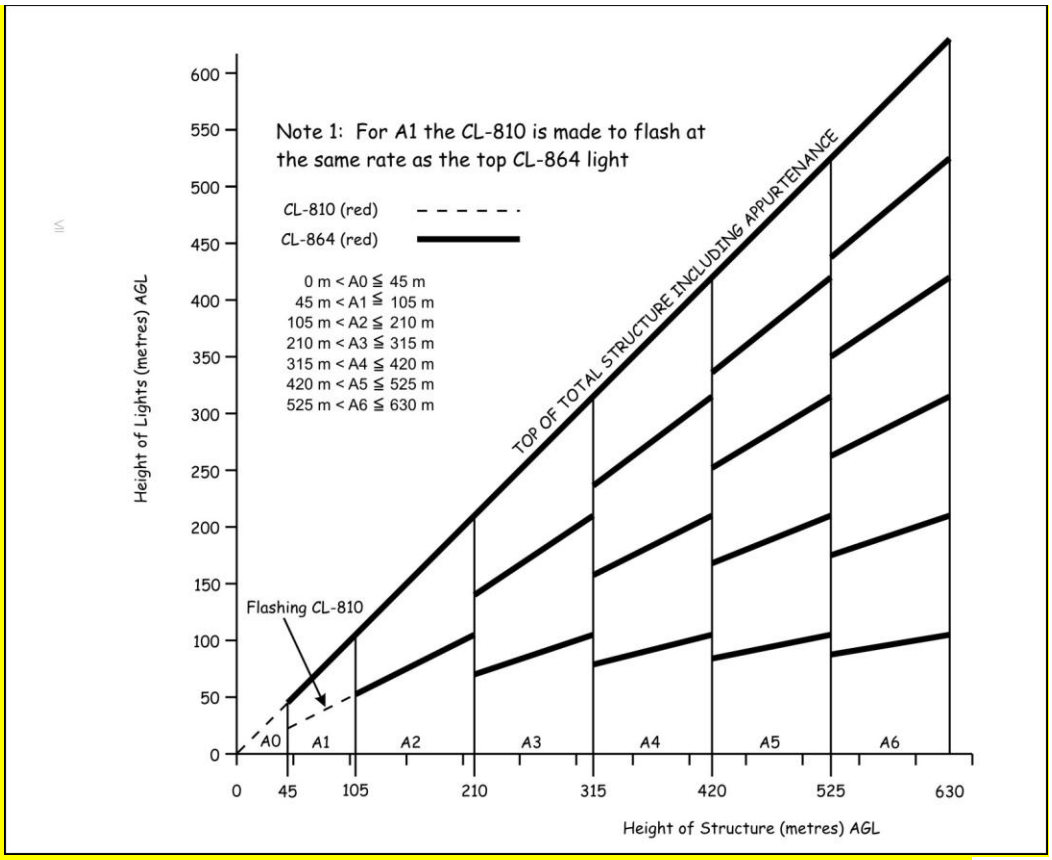

Figure 5-3: Alternative Configuration A - Lighting reduction to reduce bird fatalities

5.5 Chimneys, Flare Stacks and Similar Solid Structures

~~(1) **Lighting Levels and Location**~~

~~*(a)* CL-810 and CL-864 obstruction lights used on a chimney, flare stack or similar solid structure are installed in accordance with Figures 5-1.~~

~~*(b)* The topmost lights may be located up to 6 m below the top of the structure to avoid the obscuring effect of emissions.~~

(1) **Number of Light Units per Level.** Subject to article 5.5(3), the number of lights to be installed at the top and at each level of a chimney, flare stack or similar solid structure depends on the diameter of the structure and is in accordance with Table 5-1.

Table 5-1: Number of lights

Diameter	Minimum Number of Lights at top and per level
≤ 6 m ~~6 m or less~~	3
6 m < x ≤ 30 m ~~6 m to 30 m~~	4
30 m < x ≤ 60 m ~~30 m to 60 m~~	6
x > 60 m ~~more than 60 m~~	8

(2) *Top Mounted Obstruction Lights*.

(a) For structures 45m AGL or less, CL-810 lights are installed horizontally at regular intervals at or near the top.

(b) For Structures Exceeding 45m AGL, at least three CL-864 beacons are installed.

(c) For chimneys, cooling towers, and flare Stacks, lights may be displayed as low as 6m below the top to avoid the obscuring effect of deposits and heat generally emitted by this type of structure.

(d) For flare stacks, as well as other structures associated with the petrol-chemical industry, depending upon assessment, normal lighting requirements may not be necessary. This could be due to the location of the flare stack/structure within a large well-lighted petrol-chemical plant or the fact that the flare, or working lights surrounding the flare stack/structure, is as conspicuous as obstruction lights.

Information note: It is important that the lights be readily accessible for cleaning and lamp replacement.

(3) Mounting Intermediate Levels.

(a) Steady Burning (CL-810) Lights. The number of light levels is obtained from Figure 5-1. At least three lights are be installed on each level.

(b) Flashing (CL-864) Beacons. The number of beacon levels may be obtained from Figure 5-1. At least three lights are installed on each level, and

(i) For Structures 105 m AGL or less, intermediate levels of flashing lights are not required.

(ii) Structures Exceeding 350 Feet (107m) AGL at least three flashing (L-864) beacons should be installed on each level in a manner to allow an unobstructed view of at least one beacon.

(4) Hyperbolic Cooling Towers. Where any cooling tower ~~of a nuclear generating station~~:

(a) is 180 m in height or less AGL, intermediate light levels may be omitted; or

(b) exceeds 180 m AGL in height, a second level of light units is installed approximately at the midpoint of the structure and in a vertical line with the top level of lights.

5.6 Prominent Buildings and Similar Extensive Obstructions

(1) Subject to paragraph (4), individual obstructions having a similar height above ground and located not more than 45 m apart within a group of obstructions may be considered as an extensive obstruction for lighting purposes, in which case the group displays steady burning red lights to indicate the extent of the obstruction as specified in this section.

(2) On a structure 45 m or less in both horizontal dimensions, ~~a CL-810 light is displayed~~:

(a) a CL-810 light is displayed on the highest point at each end of the major axis of the obstruction; or

(b) a dual CL-810 light is displayed in the centre of the highest point.

(3) On a structure exceeding 45 m in at least one ~~any~~ horizontal dimension

(a) ~~On a structure exceeding 45 m in any horizontal dimension~~, CL-810 lights are displayed on:

(i) the highest point at each end of the obstruction, and

(ii) the highest points for each 45 m, or fraction thereof, for the overall length of the major axis.

(b) For ~~If~~ the minor axis of a structure exceeding 45 m in one of its horizontal dimensions is 45 m or less in length, the lights referred to in paragraph (a) may be installed as a row along the middle or along either side, as shown in Figure 5-4.

(c) If a structure exceeding 45 m in any horizontal dimension is located near a landing area and two or more edges of the structure are of the same height, the edge nearest the landing area is lighted with CL-810 lights.

(4) Structures Exceeding 45 m AGL

(a) Top Lights – CL-810 steady burning red lights are installed on the highest point at each end ~~of a structure exceeding 45 m AGL in height~~.

(b) At intermediate levels of the structure,

(i) a CL-810 steady burning red ~~light is~~ lights are displayed for each 45 m or fraction thereof,

(ii) the vertical position of the intermediate lights is equidistant between the top lights and the ground level as the shape and type of obstruction will permit, and

(iii) one CL-810 steady burning red light is displayed at each outside corner on each level with the remaining lights evenly spaced between the corner lights.

(5) Exceptions. Flashing red CL-864 beacons may be used instead of CL-810 steady burning lights if early or special warning to pilots is necessary, provided that, in the case of an extensive obstruction:

(a) they are displayed on the highest points of the obstruction, at intervals not exceeding 900 m; and

(b) at least three beacons are displayed on one side of the obstruction to indicate a line of lights.

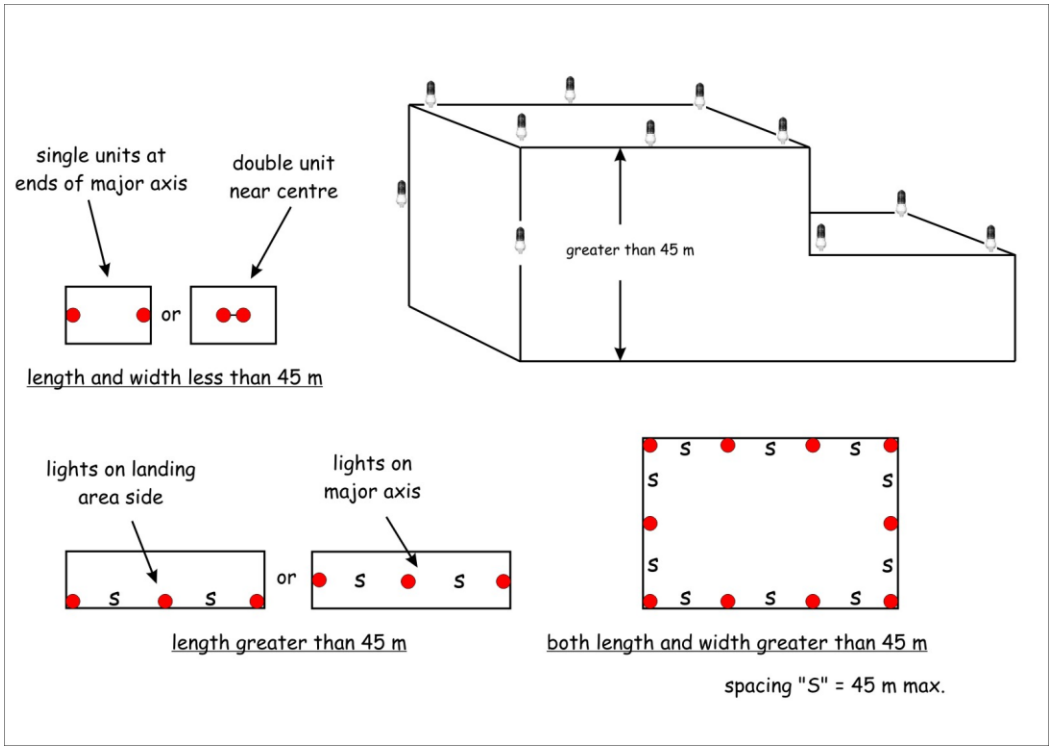

Figure 5-4: Prominent Buildings lighting

5.7 Bridges

(1) A bridge assessed through a risk evaluation as a likely hazard to aviation safety has CL-864 red flashing lighting, as shown in Figure 5-5.

(2) If the bridge referred to in paragraph (1) is over navigable water, the obstruction lighting installer consults with the Coast Guard to avoid interference with signals to marine navigation.

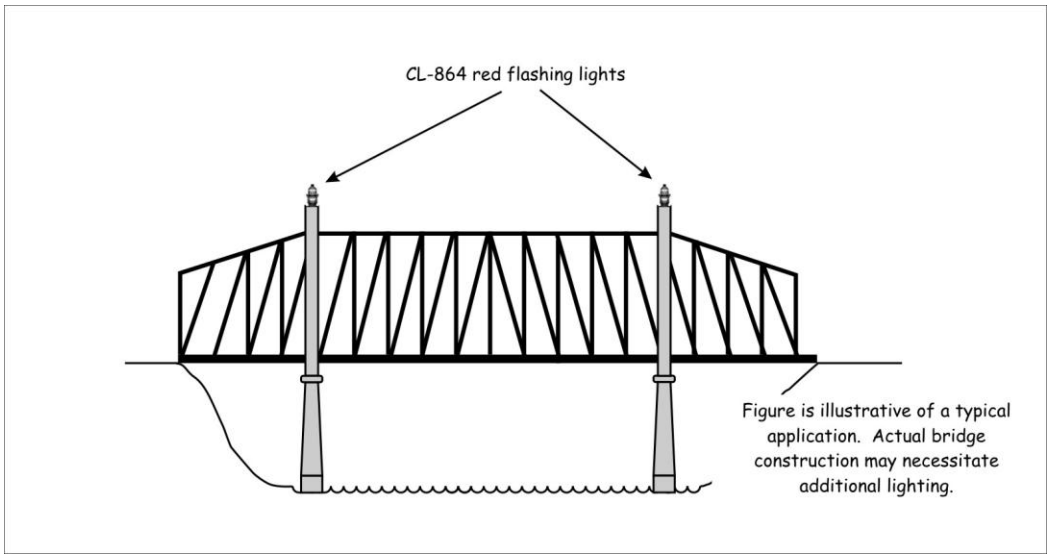

Figure 5-5: Bridge lighting

5.8 Groups of Objects

~~(1) **Of Different Height**~~
~~*(a)* A group of objects, except wind turbines, of varying heights is lighted in accordance with the requirements specified for individual obstructions of a corresponding height.~~
~~*(b)* In addition, at least one medium intensity flashing white light is installed at the top of a prominent centre obstruction or on a special tower located near the centre of the group.~~

~~(2) **Of Similar Height**~~
~~A group of objects of equal height is lighted in accordance with the requirements specified in section 5.5.~~

(1) When objects within a group of obstructions are approximately the same overall height AGL and are located not more than 45 m apart, the group of obstructions may be considered an extensive obstruction and lighted in accordance with section 5.6.

Information Note: Where the objects are not more than 45m apart, the grouping effectively simulates a building for the pilot as shown in Figure 5-6. The lights are installed as in 5-3 and some of the objects may be unlighted.

(2) Where individual objects, except windturbines, within a group of closely spaced obstructions may or may not be of same height and the spacing between individual structures is not in all cases equal to or less than 45 m apart:

(a) the prominent objects within the group are lighted in accordance with the standards for individual obstructions of a corresponding height.

(b) If the outer structure is shorter than the prominent, the outer structure is lighted in accordance with the standards for individual obstructions of a corresponding height.

(d) In addition, at least one flashing beacon is installed at the top of a prominent center obstruction or on a special tower located near the center of the group.

Information Note: The emphasis is on "closely spaced" and for which the central beacon can serve for protection of the overall group. Because of the variation, the installation should be subject to assessment by TCCA.

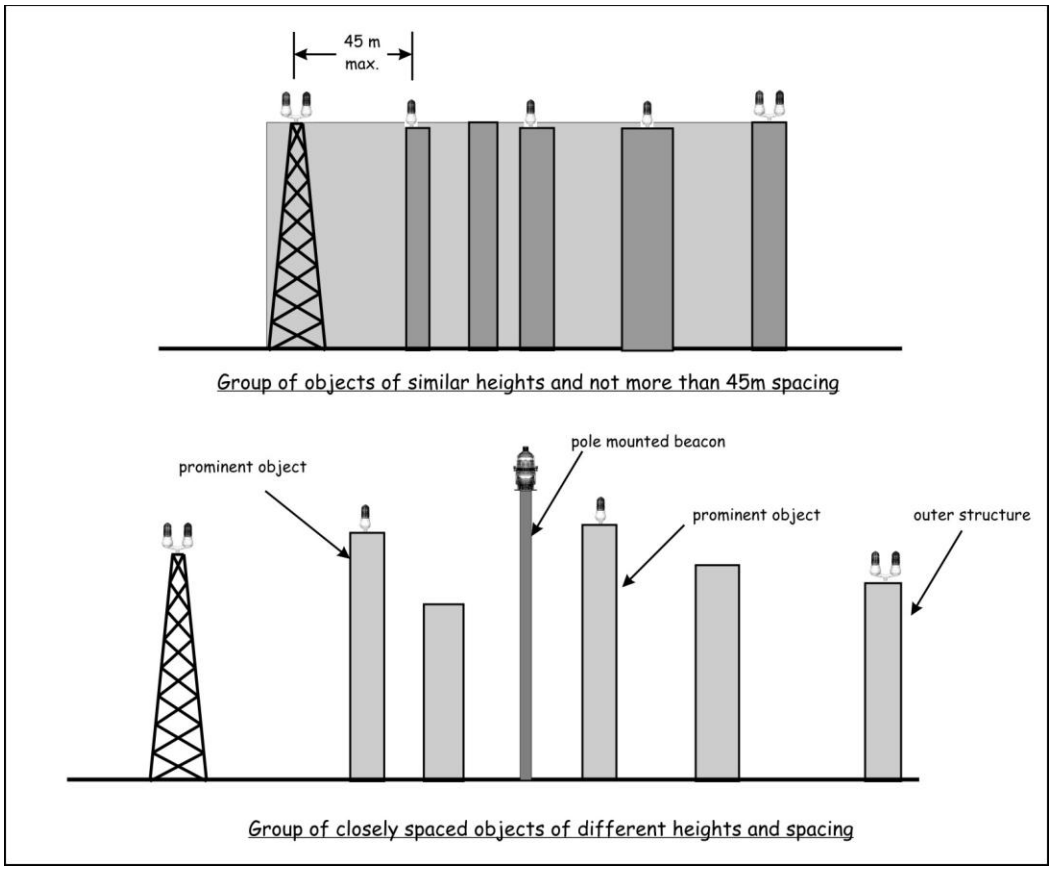

Figure 5-6: Groups of objects

5.9 ~~5.8~~ Characteristics of Lights

Lighting displayed on a bridge has the light characteristics specified in Chapter 13.

5.10 Ice Shields

Where icing is likely to occur and metal grates or similar protective ice shields are installed directly over each light unit to prevent falling ice or accumulations from damaging the light units, the lights are mounted in a manner to ensure an unobstructed view of at least one light by a pilot approaching from any direction.

5.11 Crane Lighting

Cranes are provided with lighting for twilight and night protection. Figure 5-7 illustrates the application of red lighting for a horizontal jib crane, a gantry crane and a temporary crane affixed to an existing structure. The Figure 5-7 assumes a limiting height of not more than 130 m.

Information Note. Should the height be more than 130m, the application of lighting is subject to a risk assessment by the Minister.

(1) For a horizontal jib crane, the lighting of the jib is CL-810 lights installed at intervals of not more than 45 m as described in Article 5.6 *Prominent Buildings and Similar Extensive Obstructions*. The lighting of the vertical support is shown in the inset schematic of Figure 5-7 and as described in Article 5.3 *Poles, Radio and Television Towers and Similar Skeletal Structures*.

(2) For a gantry crane the lighting on the boom is applied as if the boom were vertical and the top light and intermediate level lighting is according to Article 5.3.

(3) For a temporary crane affixed to an existing structure or structure under construction lighting is applied as if the crane were vertical and the top light and intermediate level lighting is according to Article 5.3 with the height being that of the crane plus the existing structure.

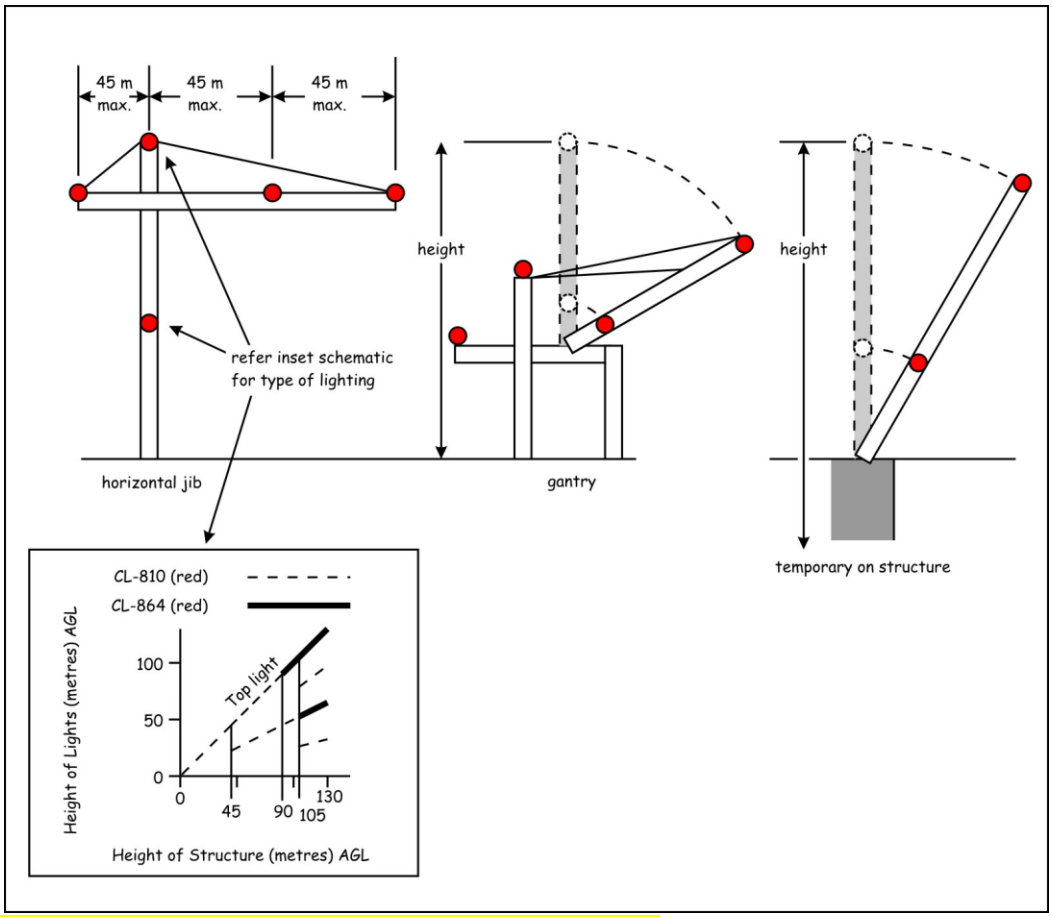

Figure 5-7. Crane Lighting for Twilight/Night Protection.

Chapter 6 - Medium intensity white system, configuration "D"

6.1 Scope

Chapter 6 governs obstruction lighting that uses a configuration "D" lighting system.

Information note: The CL-865 light can be of two forms: (1) a strobe type which produces a flash by means of an omnidirectional burst of light output, or (2) by means of rotation creating a beam of light which passes the pilot eye producing a flashing display.

6.2 Application

(1) Use of CL-865 medium intensity white flashing light units:

(a) during daytime and twilight with automatically selected reduced intensity for night time operation;

(b) where used on a building, structure or object 150 m AGL or less in height, ~~may result in~~ day marking otherwise required under Chapter 3 can be ~~being~~ omitted ~~on the building, structure or object~~; and

~~(c) where used on a building, structure or object greater than 150 m AGL, shall not result in any day marking required under Chapter 3 being omitted on the building, structure or object.~~

(c) are designed so that all lights on the tower flash synchronously.

Information Note 1: Strobe type CL-865 medium intensity white flashing light units should not be used:

(a) on a building, structure or object 60 m AGL or less in height;

(b) in ~~populated~~ urban areas due to their tendency to merge with background lighting making it difficult for some types of aviation operations;

(c) in these areas at night and ~~the~~ can be a cause of residential glare complaints; and

(d) on structures within 5 kilometres of an airport.

6.3 Characteristics

(1) **Photometrics.** The photometric output of a configuration "D" lighting system is in accordance with Table 13-2.

(2) **Control**

The lighting system is in accordance with Table 13-1 for day, twilight and night modes of operation.

6.4 Radio and Television Tower and Similar Skeletal Structures

(1) Subject to paragraph (4), on a radio or television tower, or similar skeletal structure, the number of light levels to be installed depends on the height of the structure, including antennae and similar appurtenances, and is determined in accordance with Figure 6-1.

Information Note: The location of the topmost light [as may be installed for an appurtenance] determines the overall height of the structure and thus the intermediate levels. If lighting is installed on a tower and an appurtenance is later installed, additional lighting may be applied to address the appurtenance without changing the location of lighting originally installed on the tower. The additional lighting, however, is designed to flash synchronously with the original lighting. This is intended for appurtenances not significantly more than 12 m. The lighting should be modified if the addition to the object is significantly more than 12 m in height.

(2) **Top Level.** One or more light units are installed at the highest point of a skeletal structure to provide 360-degree coverage ensuring an unobstructed view.

(3) Intermediate Levels. At an intermediate level of a skeletal structure, two CL-865 beacons are mounted outside, at diagonally or diametrically opposite positions of the intermediate level.

(4) Lowest Level. At the lowest level of light units of a skeletal structure:

(a) the light units may be installed at a higher elevation than that required under this section for the

structure, if the surrounding terrain, trees, or any adjacent building would obscure the light units; and
(b) in circumstances determined by a risk evaluation, the light units may be omitted.~~; and~~
~~(c) CL-865 light units are not to be installed at a height of less than 60 m.~~

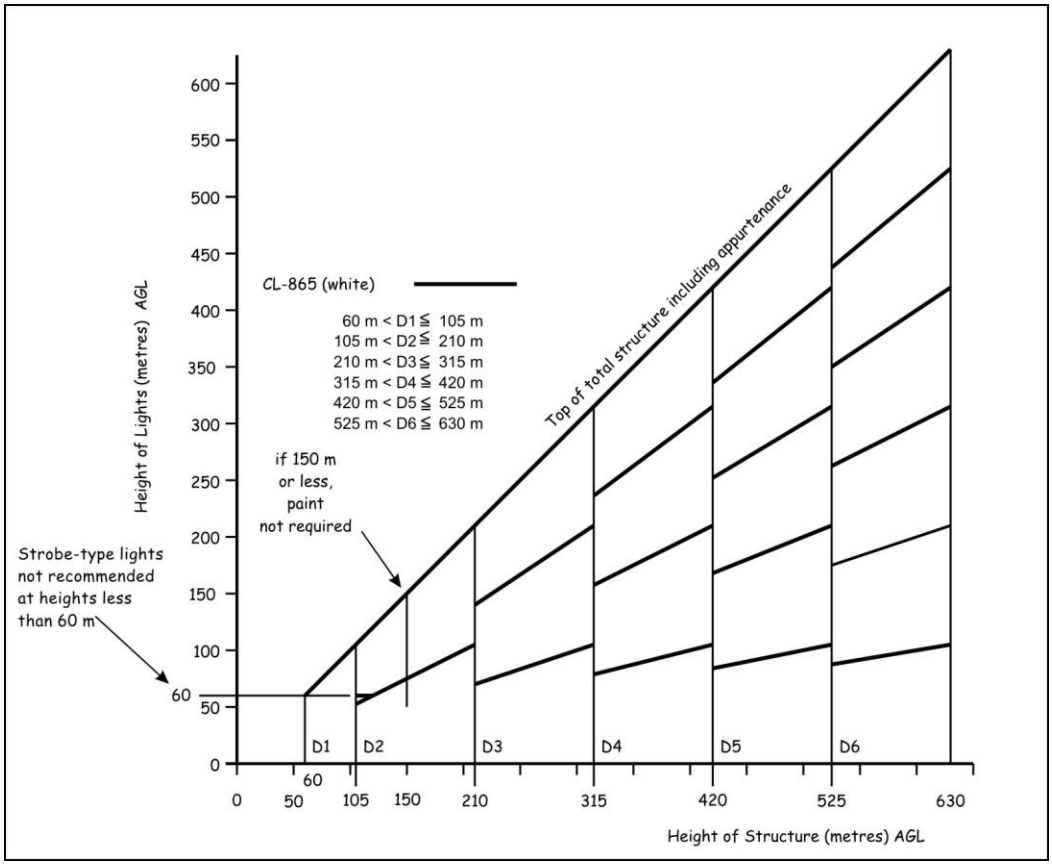

Figure 6-1: Medium intensity white flashing lighting system; Configuration "D"

(5) Structures 150 m AGL or Less. When white lights are used during nighttime and twilight only, marking is required for daytime. When operated 24 hours a day, other methods of marking and lighting are not required.

(6) Structures Exceeding 150 m AGL. The lights should be used during nighttime and twilight and may be used 24 hours a day. Marking is always required for daytime.

(7) Appurtenances. An appurtenance is lighted in accordance with the requirements specified in paragraph 5.3(3), except as far as the use of the CL-865 light in place of CL-864 light is concerned.

6.5 Chimneys, Flare Stacks, and Similar Solid Structures

(1) Lighting Levels and Location. The number of levels of light units required to be installed on a chimney, a flare stack or similar solid structure is determined in accordance with Figure 6-1.

(2) Number of Light Units per Level. The number of light units required to be installed on each level of a solid structure referred to in paragraph (1), is determined in accordance with Table 5-1.

6.6 Hyperbolic Cooling Towers

A hyperbolic cooling tower is lighted in accordance with the requirements specified in section 5.4.

6.7 Prominent Buildings and Similar Extensive Obstructions

When objects within a group of obstructions are approximately the same overall height above the surface and are located a maximum of 45 m apart, the group of obstructions may be considered an extensive obstruction. Install light units on the same horizontal plane at the highest portion or edge of prominent obstructions. Light units are placed to ensure that the light is visible to a pilot approaching from any direction. Lights are displayed to indicate the extent of the obstruction as follows:

(1) Structures 45 m or Less in All Horizontal Directions.

(a) Display at least one light on the highest point at each end of the axis of the obstruction.
(b) If the above (a) is impractical because of the overall shape, a double obstruction light is displayed in the center of the highest point.

(2) Structures Exceeding 45 m in at Least One Horizontal Direction.

(a) Display at least one light for each 45 m or fraction thereof, of the overall length of the major axis.
(b) At least one of these lights required in (a) is displayed on the highest point at each end of the obstruction.
(c) Additional lights are displayed at approximately equal intervals not to exceed 45 m on the highest points along the edge between the end lights.
(d) If an obstruction is located near a landing area and two or more edges are the same height, the edge nearest the landing area is lighted.

(3) Structures Exceeding 45 m AGL.

(a) Lights are installed on the highest point at each end.
(b) At intermediate levels, lights are displayed for each 45 m, or fraction thereof.
(c) The vertical position of these lights is equidistant between the top lights and the ground level as the shape and type of obstruction will permit.
(d) One light of (c) is displayed at each outside corner on each level with the remaining lights evenly spaced between the corner lights.

~~(1) Application is that of section 5.7, except with the use of CL-865 medium intensity white flashing lights.~~

~~**(4)** Due to the glare factor, caution shall be used in the application of medium intensity white flashing lights.~~

Information Note. Due to the glare factor, caution should be used in the application of strobe-type medium intensity white flashing lights.

6.8 Bridges

A bridge is lighted in accordance with the requirements specified in section 5.6.

Chapter 7 - High Intensity White System, Configuration "B" and "C"

7.1 Scope

Chapter 7 governs obstruction lighting that uses a configuration "B" and "C" lighting system.

7.2 Application

When a high intensity white flashing lighting system is operated 24 hours a day, the marking requirements and the other applicable lighting requirements for an obstruction may be omitted.

Information Note: This lighting system is not recommended on structures 150 m AGL or less, unless a risk evaluation shows otherwise.

7.3 Characteristics

(1) Photometrics. The photometric output of a high intensity white flashing lighting system is in accordance with Table 13-2.

(2) Control. The lighting system is controlled in accordance with Table 13-1 for day, twilight and night modes of operation.

7.4 Installation

(1) Vertical Aiming. In order to avoid potential glare problems, the vertical aiming angle of a CL-856 light unit used in a high intensity white flashing system is as follows:

(a) **Location:** the unit is adjusted to compensate for its height above ground, in accordance with Table 7-1; and

Table 7-1: Vertical Aiming of HI Light Units

Location of light unit AGL (metres)	Beam angle adjustment (degrees)
x ≥ 150 m ~~higher than 153 m~~	0
122 ≥ x > 150 m ~~122 to 153 m~~	1
92 ≥ x > 122 m 123 ~~92 to 121 m~~	2
92m > x ~~lower than 92 m~~	3

(b) **Terrain:**

(i) where terrain, nearby residential areas, or other situations dictate, the light beam of a light unit may be further elevated above the horizontal,

(ii) the main beam of light unit located at the lowest level of a building, structure or object shall not strike the ground closer than 5 km from the building, structure or object,

(iii) if additional adjustments are necessary, light units may be individually adjusted upward, in 1 degree increments, starting at the bottom of the building structure or object,

(iv) excessive elevation, however, may reduce conspicuousness by raising the beam above a collision course flight path,

(v) where the lighting system is installed on a building, structure or object located near a highway, waterway, or airport approach area, shielding or vertical or horizontal aiming adjustments, or both, shall be made as necessary to avoid causing glare, and

(vi) adjustment of light units shall not derogate from the conspicuousness requirement set out in section 2.1 of this Standard.

(2) Relocation or Omission of Light Units. Where any light units are obstructed from view by a building, structure or object, including surrounding terrain and trees, the following actions may be taken:

(a) **Lowest Level:** in the case of the lowest level of lights:

(i) As shown in Figure 7-1, the light units may be installed at a higher elevation than that required under Chapter 7, and
(ii) in circumstances determined by a risk evaluation, the light units may be omitted.; ~~and~~

(b) **Two Adjacent Structures:** As shown in Figure 7-2 and Figure 7-3, in the case of adjacent buildings or structures:

(i) if two buildings or structures are situated within 150 m of each other and their respective light units are installed at similar levels, the light units on the sides of the buildings or structures facing each other may be omitted provided that all lights on both structures flash simultaneously, except for adjacent catenary support structures,
(ii) vertical placement of the lights to either or both structures' intermediate levels is adjusted to place the lights on the same horizontal plane,
(iii) where one building or structure is higher than the other, one or more complete levels of light units, as the case may be, is installed on that part of the higher building or structure that extends above the top of the lower structure, and
(iv) if the structures are of such heights that their respective levels of lights cannot be placed in identical horizontal planes, the levels of light units are placed such that the centre of the horizontal beam patterns does not face toward the adjacent building or structure.; ~~and~~

Information Note: For example, based on subparagraph (iv) above, structures situated north and south of each other will have the light units on both structures installed on a northwest/southeast and northeast/southwest orientation.

(c) Three or More Adjacent Structures: the treatment of a cluster of structures as an individual or a complex of structures is determined by way of a risk evaluation, taking into consideration the location, heights, and spacing with other structures.

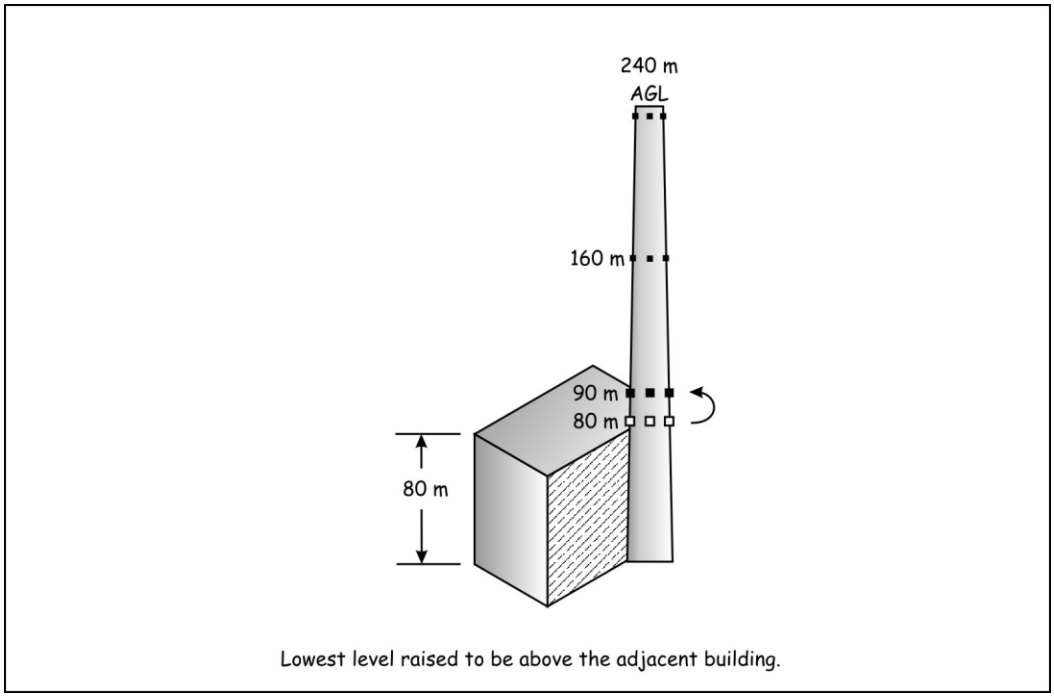

Figure 7-1: Adjacent building

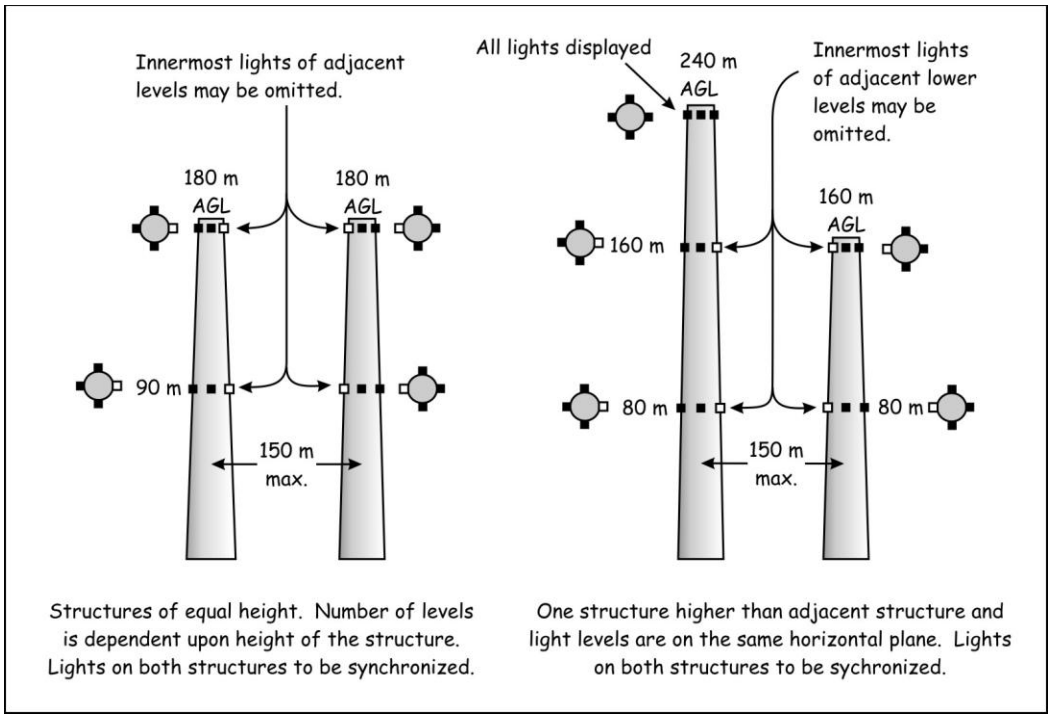

Figure 7-2: Lighting Adjacent Structures

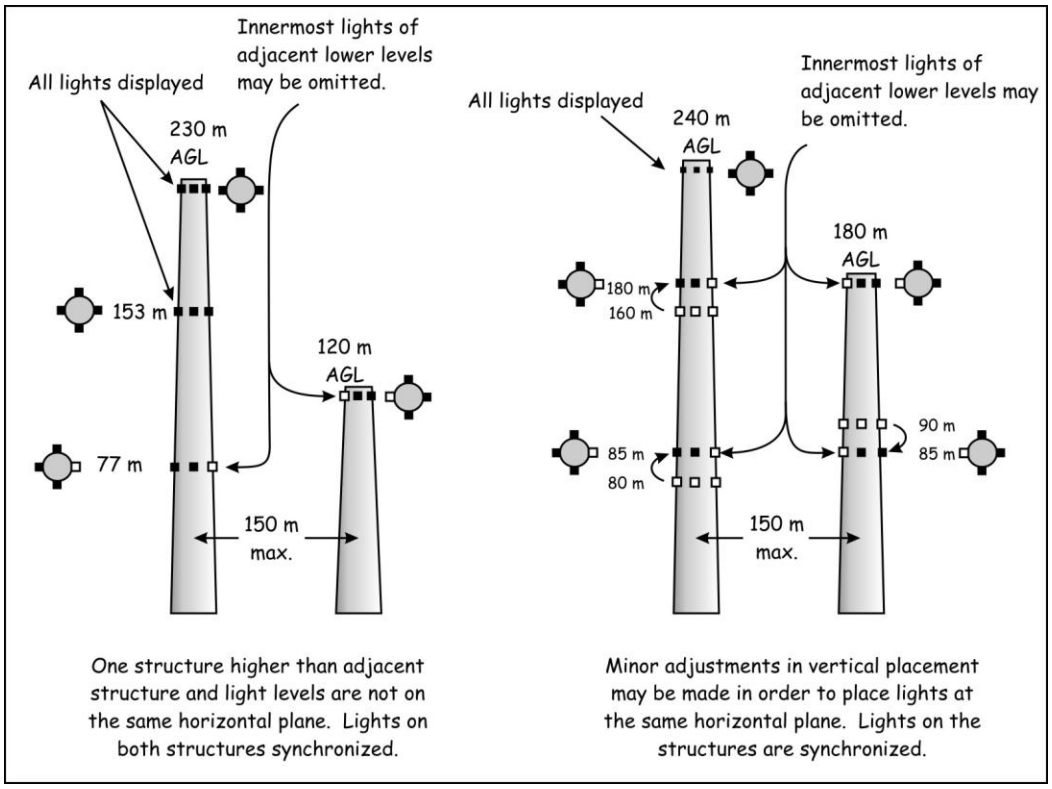

Figure 7-3: Lighting Adjacent Structures

7.5 Radio and TV Towers and Similar Skeletal Structures

(1) Top Level. On a radio, TV tower or similar skeletal structure, one level of light units is installed within 3 m of the highest point of the main structure.

(2) Intermediate Levels. On a skeletal structure referred to in paragraph (1):

(a) the number of levels of light units to be installed depends on the height of the structure, excluding any appurtenances, and is determined in accordance with Figure 7-4; and

Information Note 1: The number of levels for the high intensity lights of Configuration B is determined from the height of the main structure excluding any appurtenance. Where the appurtenance exceeds 12 m, a medium intensity light is installed on the top of the appurtenance or within 12 m of the top of the appurtenance and the combination of lighting is Configuration C.

Information Note 2: It is intended that Configuration C is to address appurtenances that are not significantly in excess of 12 m. Where the appurtenance is significantly in excess of 12 m the Minister may deem a portion of such appurtenance to be considered a part of the main structure and lighting to be provided accordingly.

(b) at least three lights are installed on each intermediate level and mounted to ensure that the effective intensity of the full horizontal beam coverage is not impaired by the structural members.

(3) **Appurtenances.** Where a skeletal structure has an appurtenance in excess of 12 m in height above it:

(a) a medium intensity white flashing light is installed in accordance with paragraph 6.4(5); and

(b) the light referred to in paragraph (a) operates 24 hours a day and flashes simultaneously with the rest of the lighting system installed on the structure.

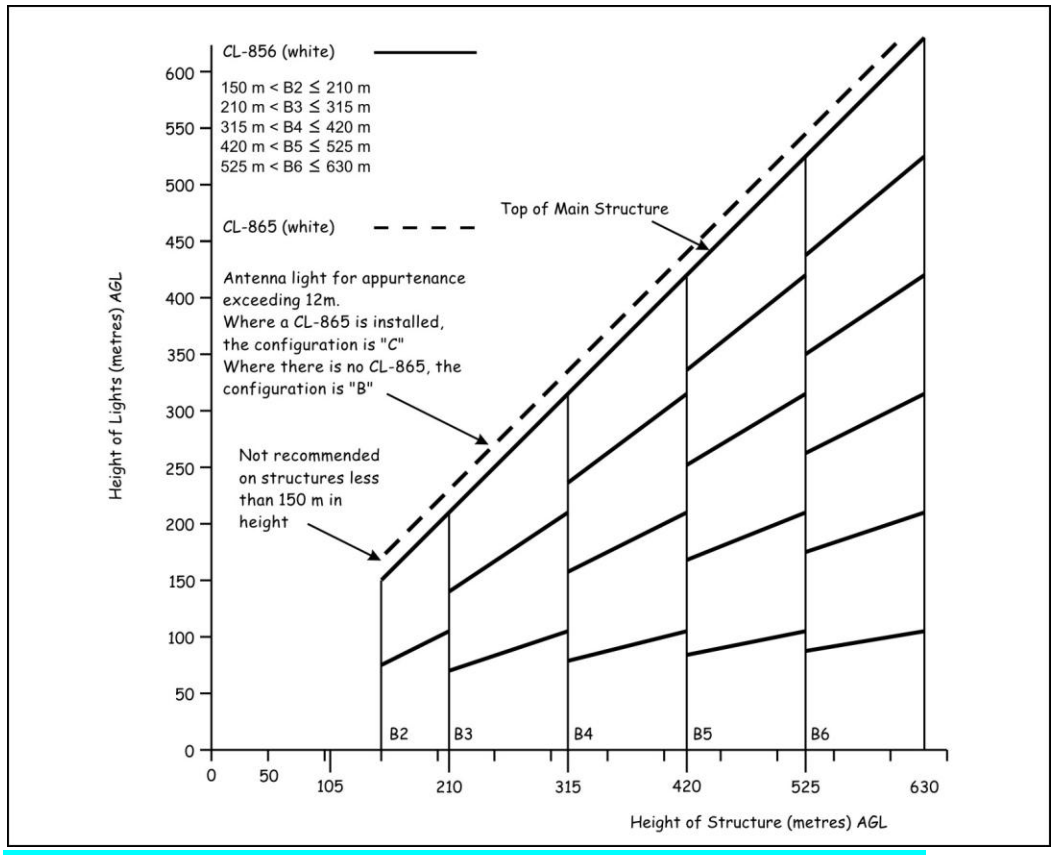

Figure 7-4: High Intensity White Flashing System - Configuration "B" and "C"

7.6 Chimneys, Flare Stacks and Similar Solid Structures

(1) Lighting Levels and Location. Subject to 7.6(3), the number of levels of light units required to be installed on a chimney, flare stack or similar solid structure is determined in accordance with Figure 7-4.

(2) Number of Light Units per Level. The number of light units required to be installed on each level of the high intensity white flashing lighting system of a structure referred to in paragraph (1), is ~~be~~ determined in accordance with Table 5-1.

(3) Hyperbolic Cooling Towers. Where any cooling tower of a nuclear generating station:

(a) is 180 m in height or less AGL, intermediate light levels may be omitted; or

(b) exceeds 180 m AGL in height, a second level of light units is installed approximately at the midpoint of the structure and in a vertical line with the top level of lights.

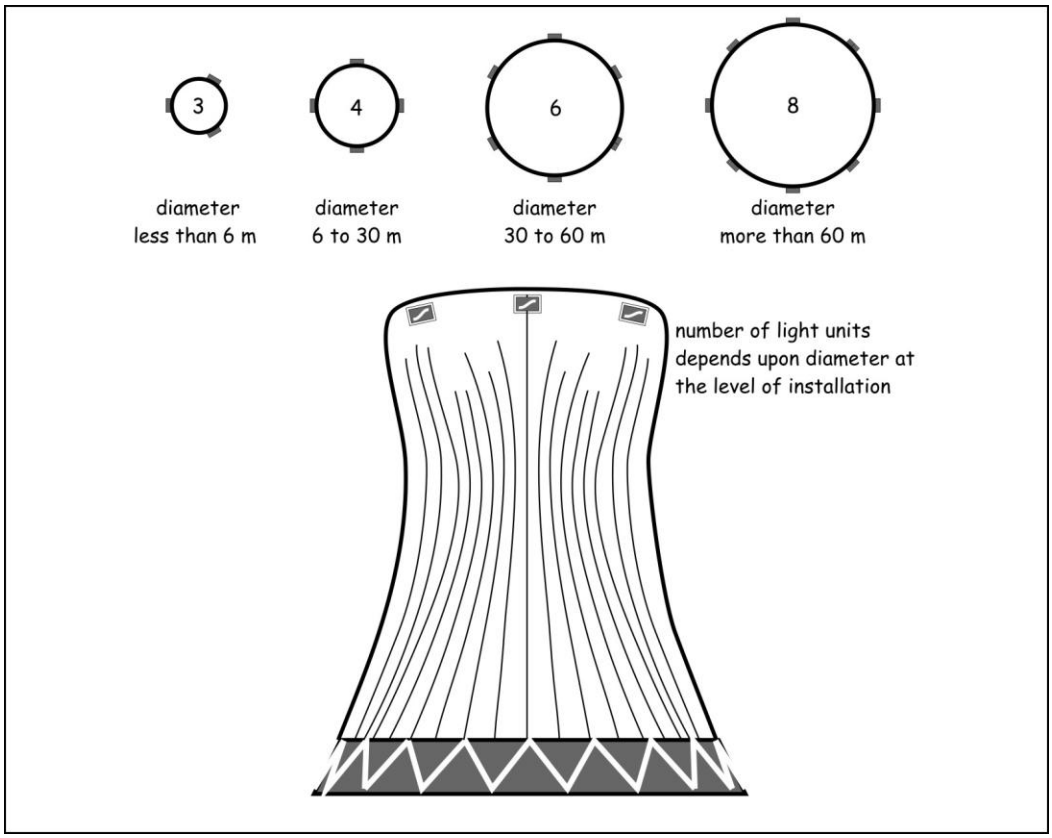

Figure 7-5: Hyperbolic Cooling Tower

7.7 Prominent Buildings, Structures and Similar Extensive Objects

(1) Individual buildings, structures or objects having a similar height above ground and located not more than 60 m apart within a group of obstructions may be considered as an extensive obstruction for lighting purposes, in which case the group displays CL-856 white flashing light units to indicate the extent of the obstruction as specified in this section.

Information Note: Owing to the glare factor, caution shall be used in the application of high intensity white flashing lights.

(2) On a structure 60 m or less in both horizontal dimensions, a CL-856 light is displayed ~~:~~in the centre of the highest point.

~~(a) on the highest point at each end of the major axis of the obstruction; or~~

~~(b) in the centre of the highest point..~~

(3) Structures Exceeding 60 m in any Horizontal Dimension

(a) On a structure exceeding 60 m in any horizontal dimension, CL-856 light units are displayed on:

(i) the highest point at each end of the obstruction, and

(ii) the highest points for each 60 m, or fraction thereof, for the overall length of the major axis.

(b) If the minor axis of a structure exceeding 60 m in one of its horizontal dimensions is 60 m or less in length, the lights referred to in paragraph (a) may be installed as a row along the middle or along either side, as shown in Figure 5-3.

(4) If the Obstruction Exceeds 60 m in Both Horizontal Dimensions, light units should be equally spaced along the overall perimeter of the obstruction at intervals of 60 m or fraction thereof.

(5) Structures Exceeding 150 m AGL

~~**Top Lights**~~

(a) Top lights: A CL-856 white flashing light unit is installed on the highest point at each end of a structure exceeding 150 m AGL in height.

(b) At intermediate levels of the structure,

(i) a CL-856 white flashing unit is displayed for each 150 m or fraction thereof,

(ii) the vertical position of the intermediate lights is equidistant between the top lights and the ground level as the shape and type of obstruction will permit, and

(iii) a CL-856 white flashing unit is displayed at each outside corner on each level with the remaining lights evenly spaced between the corner lights.

Chapter 8 - Dual Red/White Medium Intensity System, Configuration "E"

8.1 Scope

Chapter 8 governs obstruction lighting that uses a Configuration ~~configuration~~ "E" lighting system consisting of CL-810 steady burning red and CL-864 flashing red obstruction light units for nighttime operation and CL-865 medium intensity white flashing light units for daytime and twilight operation.

Information Note: This lighting system may be used in lieu of operating a CL-865 medium intensity white flashing system at night, in order to avoid glare complaints particularly in populated urban areas.

8.2 Application

(1) The light units of the system are installed as required by the relevant provisions of
(a) Chapter 4 for lighting in general;
(b) Chapter 5 for red lighting; and
(c) Chapter 6 for medium intensity lighting.

(2) The number of light levels needed is obtained from Figures 5-1 and 6-1 for the applicable components of the lighting system.

(3) Where the lighting is medium intensity light is a combined CL-865/CL-864 light unit, and it is intended that the CL-865 not be installed less than 60m height, the CL-864 is at the same location as the CL-865.

8.3 Operation

The lighting system is operated such that:
(a) both the red CL-864/CL-810 and white CL-865 systems are not operated at the same time;
(b) there is no more than a 2-second delay when changing from one system to the other; and
(c) outage of one of two lamps in the uppermost CL-864 red flashing beacon or outage of any uppermost red light causes the white CL-865 obstruction lighting system to operate in its specified "night" step intensity.

Information note: The operation is such that the CL-865 are ON for daytime [where there is no painting] and twilight; the CL-864 and CL-810 are ON for nighttime.

8.4 Control Device

The lighting system is controlled such that:
(a) a photocell device causes a change of operation from red to white lighting with an increase and decrease of the ambient light level;
(b) the system automatically changes from white to red and subsequently from red to white when the northern sky illuminance, as indicated in Table 13-1, goes through the transitions of twilight to night and night to twilight respectively; and
(c) where a malfunction requires the CL-865 white lighting system to be operated during the night, the device causes operation at the lower intensity level.

8.5 Antenna or Similar Appurtenance Light

When a structure utilizing this dual lighting system is topped with an antenna or similar appurtenance exceeding 12 m in height above the structure:
(a) a CL-865 medium intensity white flashing light and a CL-864 red flashing beacon is placed within 12 m from the tip of the appurtenance;
(b) the CL-865 white light operates during daytime and twilight and the red light during nighttime; and
(c) the lights required in paragraphs (a) and (b) flash simultaneously with the rest of the lighting system.

8.6 Omission of Marking

When medium intensity white CL-865 lights are operated on a structure 150 m AGL or less during daytime and twilight, the markings required under this Standard may be omitted on the structure.

Chapter 9 - Dual Red/White High Intensity System, Configuration "F"

9.1 Scope

Chapter 9 governs obstruction lighting that uses a configuration "F" lighting system referred to in Table 4-2.

Information Note: This lighting system may be used in lieu of operating a white flashing lighting system at night. There may be populated urban areas where the use of high intensity lights at night may cause environmental complaints.

9.2 Light Units

CL-810 and CL-864 red light units are ~~shall be~~ used for night time lighting and CL-856 high intensity white flashing light units shall be used for daytime and twilight lighting.

9.3 Installation

The light units required under section 9.2 shall be installed in accordance with the relevant provisions of Chapter 4 for lighting in general, of Chapter 5 for red CL-864/CL-810 lighting and Chapter 7 for high intensity white CL-856 flashing lighting.

9.4 Operation

A configuration "F" lighting system shall:

(a) be operated in accordance with the requirements of:
  (i) Chapter 4 for lighting in general,
  (ii) Chapter 5 for red lighting, and
  (iii) Chapter 7 for high intensity white flashing lighting;

(b) not have both red and white lighting systems operating at the same time; however, there shall be no more than a 2-second delay when changing from one colour of lighting system to the other; and

(c) where an outage of one of two lamps in the uppermost CL-864 red beacon or an outage of any uppermost red light unit occurs, have the white CL-856 lighting switched on and operating in its specified night mode of intensity.

9.5 Control Device

The light intensity of a configuration "F" lighting system shall be controlled by a photocell device set to operate in accordance with Table 13-1 for transition between day, twilight and night.

9.6 Antenna or Similar Appurtenance Light

(1) Where a configuration "F" lighting system is used on a building, structure or object that is topped with an antenna or similar appurtenance exceeding 12 m in height above it, both a CL-864 medium red flashing and a CL-865 medium intensity white flashing light unit is placed within 12 m from the tip of the appurtenance.

(2) The white light unit referred to in paragraph (1) operates during daytime and twilight, and the red light unit during night time.

9.7 Omission of Marking

When high intensity white flashing light units are operated during daytime and twilight, any day marking otherwise required under Chapter 3 to be displayed on the building, structure or object may be omitted.

Chapter 10 - Marking and Lighting of Catenaries

10.1 Scope

Chapter 10 governs obstruction marking and lighting of a catenary wire and a catenary support structure.

Information note: The catenaries described in this chapter with respect to river crossings. The same requirements for making and lighting could be applied to other catenaries over such as valleys.

10.2 Marking of Catenary Support Structures

A support structure of a power line is painted in alternate bands of orange and white in accordance with section 3.5(3) ~~section 3.4~~, and is clear of trees and brush insofar as practicable [refer to information note in section 2.1.]

10.3 Markers ~~*Shore Markers*~~

(1) Structure Markers. Markers are used to highlight support structures when it is impractical to make the structures conspicuous by painting. Markers may also be used in addition to aviation orange and white paint when additional conspicuity is necessary for aviation safety. They should be displayed in conspicuous positions on or adjacent to the structures so as to retain the general definition of the structure. The markers are recognizable in clear air from a distance of at least 1200 m and in all directions from which aircraft are likely to approach. The markers are distinctively shaped, i.e., spherical or cylindrical, so they are not mistaken for items that are used to convey other information. They are replaced when faded or otherwise deteriorated.

(2) Shore Markers. Where~~, according to a risk assessment,~~ the marking of a support structure would not clearly indicate the presence of a catenary over a waterway, shore markers are ~~a shore marker is~~ displayed as indicated in Figure 10-1, and:

(a) ~~is~~ painted aviation orange and white

(b) ~~is~~ either of:

(i) a panel type, designed as a 6 m square panel with a 5 m diameter aviation orange dot, or

(ii) a pole type.

10.4 Catenary Markers

Spherical markers are displayed on a catenary, as indicated in Figure 10-1 and as specified below, unless equivalent markings are approved by the Minister as a result of a risk assessment:

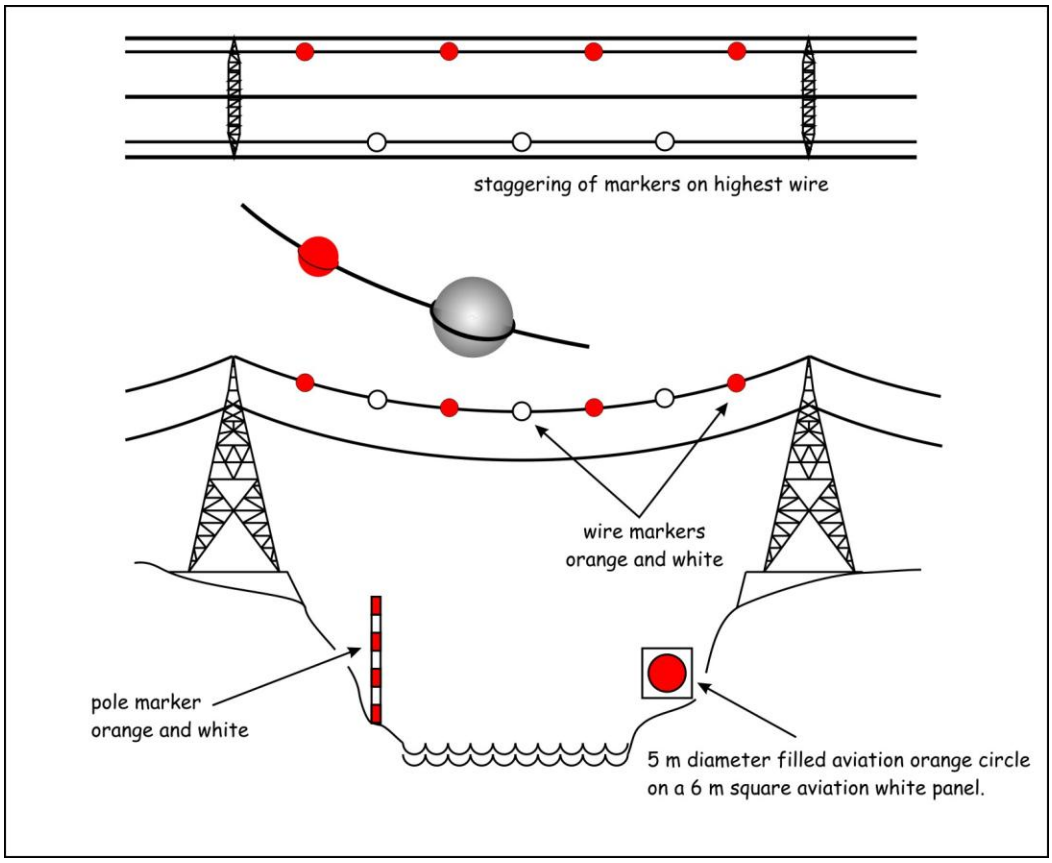

Figure 10-1: Catenary Markers

(1) **Dimensions and spacing.** Each marker has the following diameters and associated spacings on the catenary:

(a) *50 cm diameter and 30 m spacing;*

(b) *75 cm diameter and not more than 45 m spacing;*

(c) 90 cm and not more than 60 m spacing

(d) *150 cm diameter and 90 to 120 m spacing; and*

(e) *other dimensions or shapes are used provided the projected area of such markers is not less than that presented by a spherical marker or can be recognized in clear air from a distance of at least 1000 m* ~~*may be approved by the Minister, if necessary, as determined by a risk assessment, provided that due consideration is given to the overall obstacle avoidance distances referred to in section 2.1*~~.

(f) 50 cm diameter installed in critical areas near runway ends at a spacing of 10 m to 15 m.

(2) **Minimum Quantity.** Where the length of the catenary span is less than twice the spacing, depending on the size of marker as that indicated in paragraph (1), not less than two markers are used.

(3) **Location.** Markers are displayed:

(a) on the highest wire or by other means at the same height; or

(b) where there is more than one wire at the highest level, the markers may be installed alternately along each wire, as indicated in Figure 10-1, as long as the apparent distance between adjacent markers as seen by the pilot [horizontally and perpendicular to the wires] meets the spacing standard.

Information Note: This method will allow the weight and wind loading factors to be distributed.

(4) **Colour Pattern.** Markers have the following colour patterns:

(a) on overhead wires, they are marked by alternating solid colour spheres of orange and white;

(b) an orange marker is placed at each end of the overhead wire and its spacing adjusted to accommodate the rest of the markers; and

(c) when less than four markers are needed, they are all orange.

10.5 Omission of Marking

Marking of a catenary wire or a support structure may be omitted, where:

(a) the height of the support structure is 150 m AGL or less, and CL-866 lights are installed on the support structure and operated 24 hours a day; or

(b) CL-857 high intensity white flashing light units are installed on the support structure and operated 24 hours a day.

10.6 Lighting of Catenary Wires

(1) Light units are installed along a catenary wire, either separately or in combination with a day marker, provided that the light units are:

(a) used on transmission line catenary near airports, heliports, across rivers, canyons, lakes, and similar geographical features;

(b) visible by a pilot from any normal angle of approach;

(c) meet the requirements specified for the CL-810 light unit;

(d) installed ~~used~~ on the highest energized line;

(e) located within 6 m of the day marker if the light unit is separate from the day marker; and

(f) spaced at the same interval as that required for the day markers on the same catenary.

(2) Lighting of catenary wires is not required where lighting in accordance with section 10.7 or 10.8 is installed, unless otherwise determined following a risk assessment.

Information note: Where catenary wire lights and markers cannot be installed on the catenary itself [e.g. a gondola lift], installation may be made on a separate line in a manner that provides an equivalent level of safety.

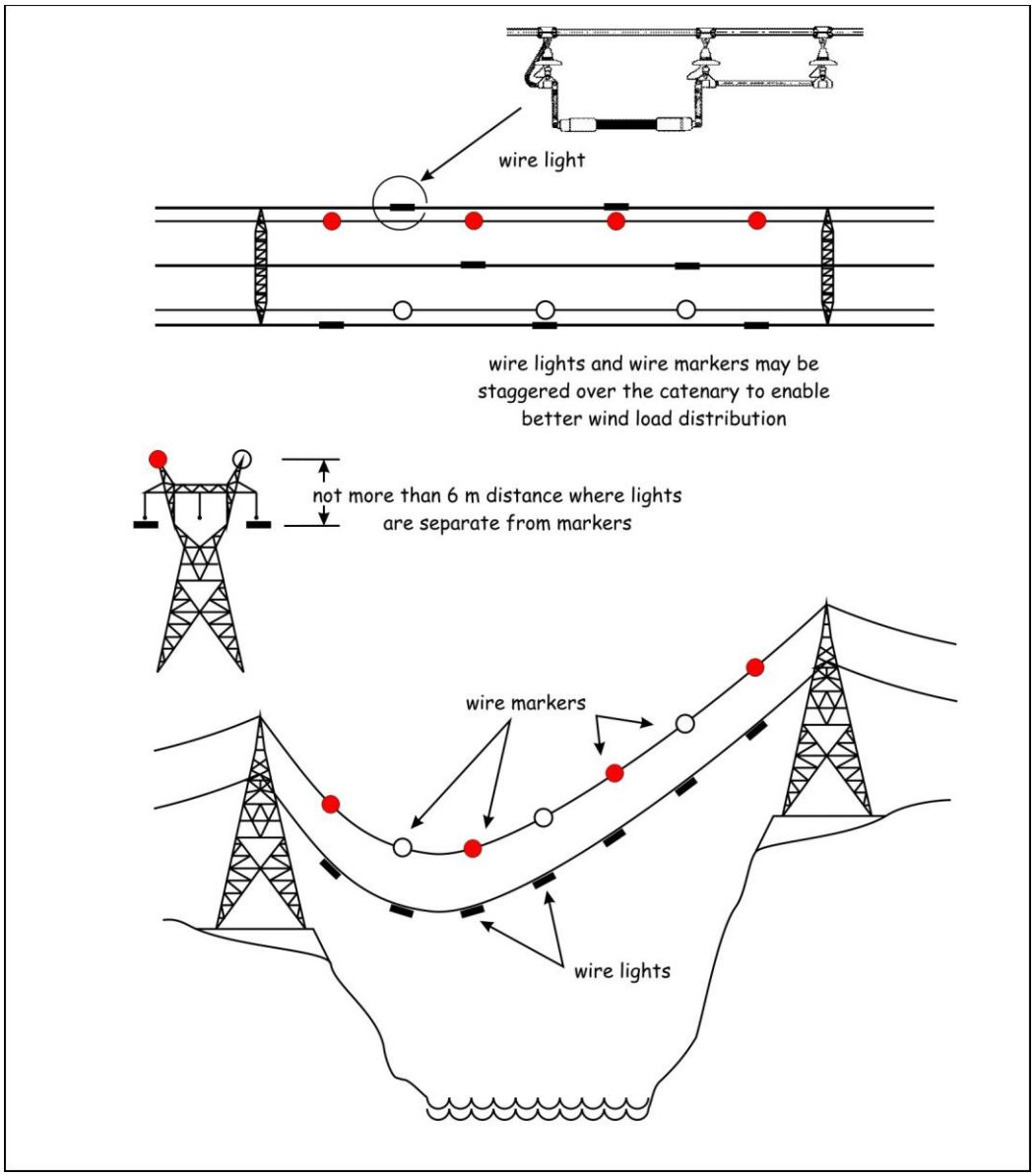

Figure 10-2: Catenary Wire Lights

10.7 ~~Daytime~~ Lighting of Catenary Support Structures

(1) Where a support structure or a power line crossing are assessed by the Minister, as a result of an Aeronautical Evaluation, as likely to be inadequately indicated ~~marked~~ by ~~the~~ painting and markers specified in Chapter 10, the support structure is lighted in daytime by medium CL-866 or high intensity CL-857 white flashing light units as follows and as illustrated in Figure 10-3.

(a) The lighting is operated at night at reduced intensity.

(b) Where residential complaint would result from the use of white lighting, a dual system of CL-866/CL-885 or CL-857/CL-885 may be installed.

(c) The lighting systems are identified as Configurations S1, S2, S3, S4 and S5 as listed in Table 13-2 and illustrated in Figure 10-4.

(d) Where a catenary wire crossing requires three or more supporting structures, the inner structures are equipped with enough light units per level to provide a full 360 degree coverage.

(e) High intensity CL-857 or dual high intensity CL-857/CL-885 systems are not recommended on structures 150 m or less in height unless an aeronautical study shows otherwise.

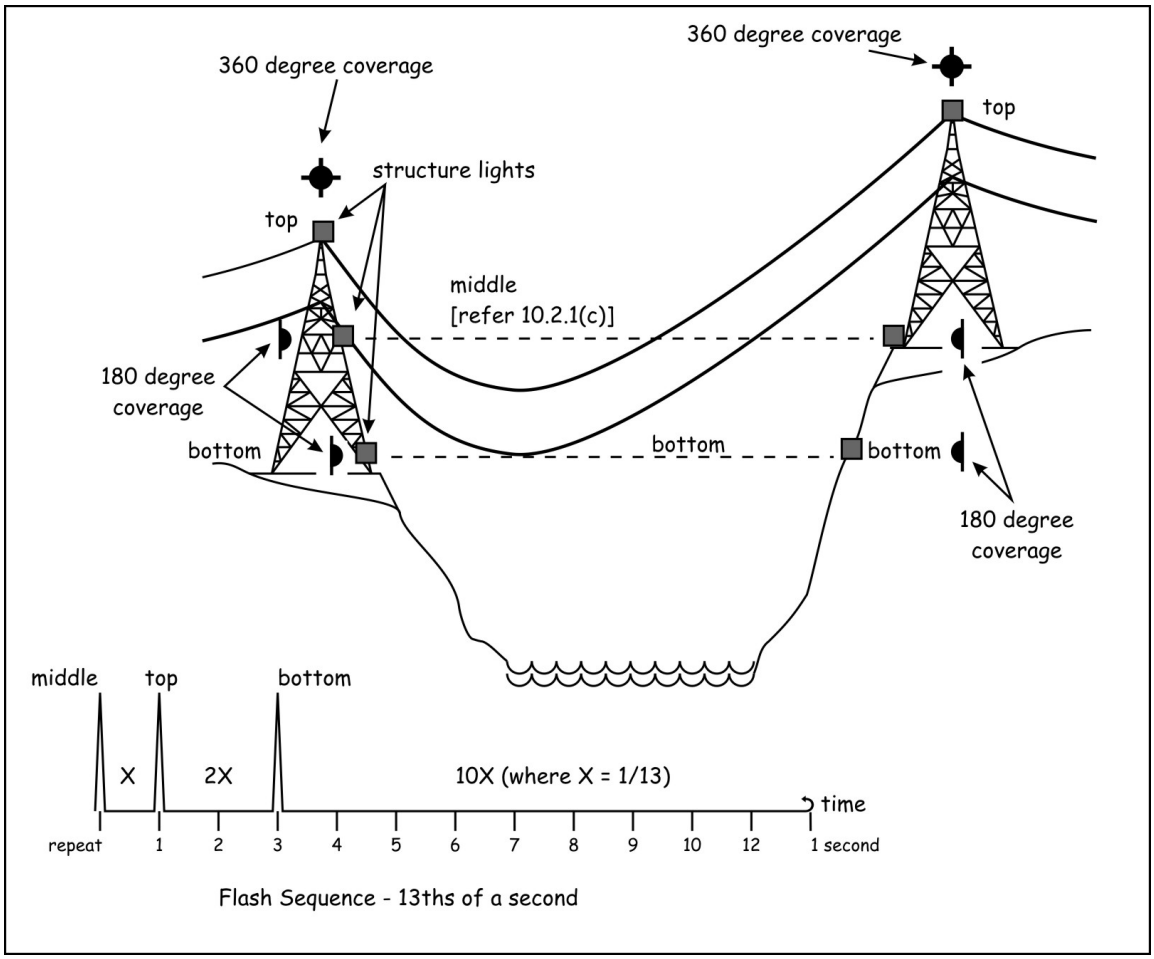

Figure 10-3: Catenary Flashing Lights

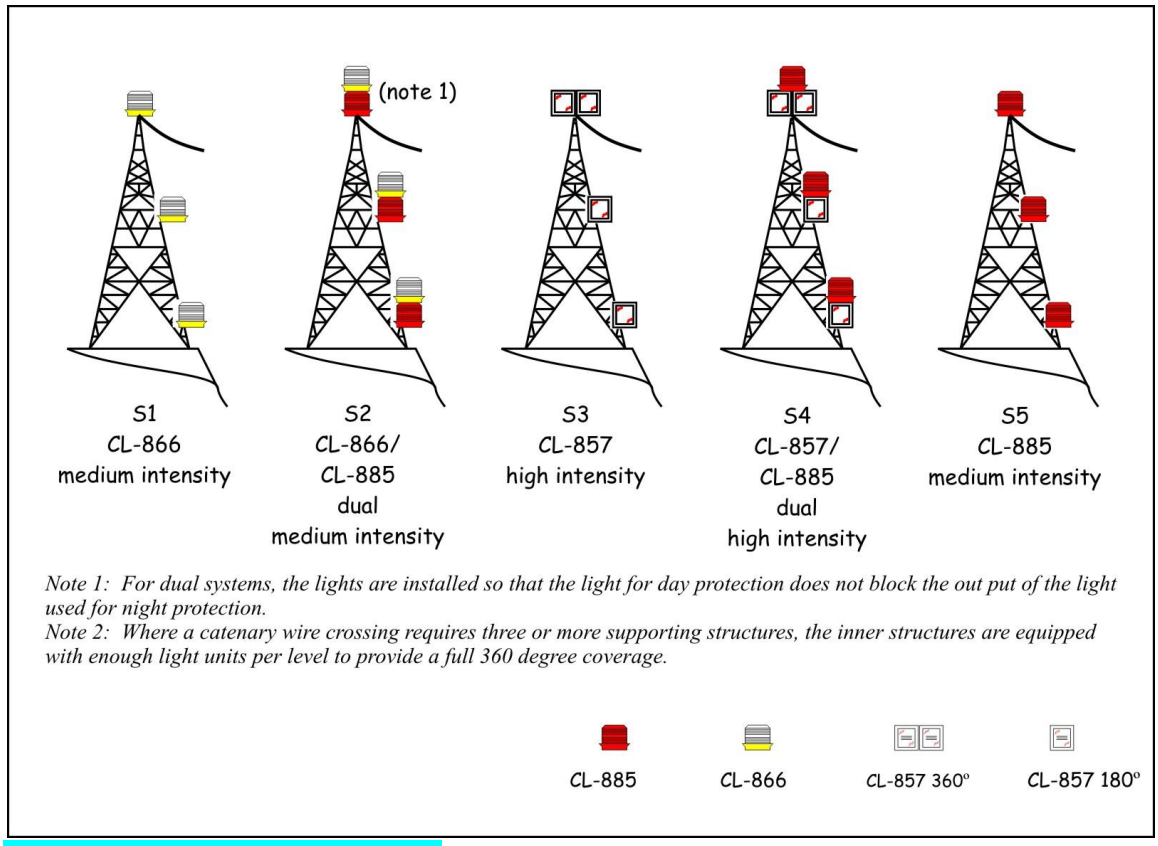

Figure 10-4: Catenary Configurations

~~**Support Structures 150 m AGL or less**~~

~~*(a)* One of the following lighting systems is approved by the Minister as part of the Aeronautical Evaluation for the catenary, where no portion of the obstruction exceeds 150 m AGL:~~

~~(i) a CL-866 medium intensity white flashing white lighting system, or~~

~~(ii) a CL-866/CL-885 dual medium intensity flashing lighting system.~~

(2) Support Structures 150 m AGL or Less. Where no portion of the obstruction exceeds 150 m AGL:

(a) When medium intensity white lights CL-866 are operated 24 hours a day, or when a dual red/medium intensity system CL-866 daytime & twilight/CL-885 nighttime is used, marking is omitted.

(b) When using a medium intensity white light (CL-866) or a flashing red light CL-885 during twilight or nighttime only, painting is used for daytime marking.

~~**Support Structures exceeding 150 m AGL**~~

~~*(b)* One of the following lighting systems is used for the catenary, where the obstruction exceeds 150 m AGL:~~

~~(i) a CL-857 high intensity white flashing lighting system, or~~

~~(ii) a CL-857/CL-855 dual high intensity flashing lighting system.~~

(3) Support Structures Exceeding 150 m AGL.

(a) When high intensity white lights (CL-857) are operated 24 hours a day, or when a dual red/high intensity system CL-857 daytime and twilight/CL-885 nighttime is used, marking can be omitted.

(b) When a flashing red obstruction light (CL-885), a medium intensity L-866 flashing white lighting system or a high intensity white lighting system L-857 is used for nighttime and twilight only, painting is used for daytime marking.

(4) Levels of Light Units. The lighting system includes light levels displayed as follows:

(a) a system of three levels of sequentially flashing light units is installed on each supporting structure or adjacent terrain as follows:

(A) at the top of the structure,

(B) at the lowest point in the catenary, and

(C) approximately midway between the other two light levels and at least 15 m from the other two levels, except that the middle light level may be deleted when the distance between the top and the bottom light levels is less than 30 m,

(b) the maximum vertical spacing tolerance allowed to accommodate structural limitations is 20 percent of the uniform spacing of the bottom and middle light units, and

(c) if the base of the supporting structure is higher than the lowest point in the catenary, such as a canyon crossing, the required light units are installed on the adjacent terrain at the level of the lowest point in the catenary.

(5) Light Coverage. The photometric coverage requirements for the light units are:

(a) in the case of the top level of light units:

(A) one or more lights are installed, subject to clause (B), at the top of the structure to provide 360 degree coverage ensuring an unobstructed view to a pilot from any normal angle of approach,

(B) if the installation presents a potential danger to maintenance personnel, or when necessary for lightning protection, the top level of light units may be mounted not more than 6 m below the highest point of the structure, provided that due consideration is given to the overall obstacle avoidance distances referred to in section 2.1, and

(b) in the case of the middle and bottom levels of light units:

(A) the light units at the middle level and bottom level are installed so as to provide a minimum of 180-degree coverage cantered perpendicular to the flyway,

(B) where a catenary crossing is situated near a bend in a river, canyon or similar geographical feature, or where it is not perpendicular to the flyway, the horizontal beam is directed to provide the most effective light coverage to warn pilots approaching the catenary wires from any normal angle of approach, and

(C) where a catenary involves three or more supporting structures, the inner structure or structures are equipped with enough light units per level to provide 360 degree coverage.

(6) Flash Sequence. The lighting system flashes as follows:

(a) each light unit has a flash frequency of 60 flashes per minute or 1 second per flash cycle (± 5 percent),

(b) the flash sequence of the levels of light units is middle, top, and then bottom,

(c) the interval between top and bottom flashes is about twice the interval between middle and top flashes, and

(d) the interval between the end of one sequence and the beginning of the next is about 10 times the interval between middle and top flashes.

(7) Synchronization. On the lighting system used for associated catenary support structures:

(a) the corresponding light levels flash simultaneously, if practicable, and

(b) where three or more supporting structures are involved and the inner structure or structures are equipped with enough light units per level to provide 360-degree coverage, the light units for each level flash simultaneously.

(8) Photocell Control. Where a medium or high intensity lighting system is used for a catenary crossing, the light intensity of the system is automatically controlled by photocell devices whose day, twilight and night transition settings conform to the specifications set out in Chapter 13 ~~Table 13–1.~~

(9) Photometric Characteristics. The photometric characteristics of the lighting system are in accordance with the requirements set out in Chapter 13.

~~**10.8 *Lighting with use of ADS***~~

~~(a) Where an Aircraft Detection System (ADS) is installed as specified in Chapter 15, each support structure is lighted, by one of the following medium intensity lighting systems as illustrated in Figure 10–2b:~~

~~*(a)* a CL-866 medium intensity white flashing white lighting system, or~~
~~*(b)* a CL-866/CL-885 dual medium intensity flashing lighting system.~~

10.8 Lighting with use of Aircraft Detection System (ADS)

As determined by a risk assessment and approved by the Minister, where an Aircraft Detection System (ADS) is installed as specified in Chapter 15, each support structure may be lighted by one of the following medium intensity lighting systems as illustrated in Figure 10-2b:

(a) a CL-866 medium intensity white flashing white lighting system, or
(b) a CL-866/CL-885 dual medium intensity flashing lighting system.

Information note: The reduced lighting with use of ADS is limited to short catenaries where a single light on each support tower is determined as sufficient. Normally, full sequenced lighting as specified in article 10.7 would be installed and controlled by the ADS.

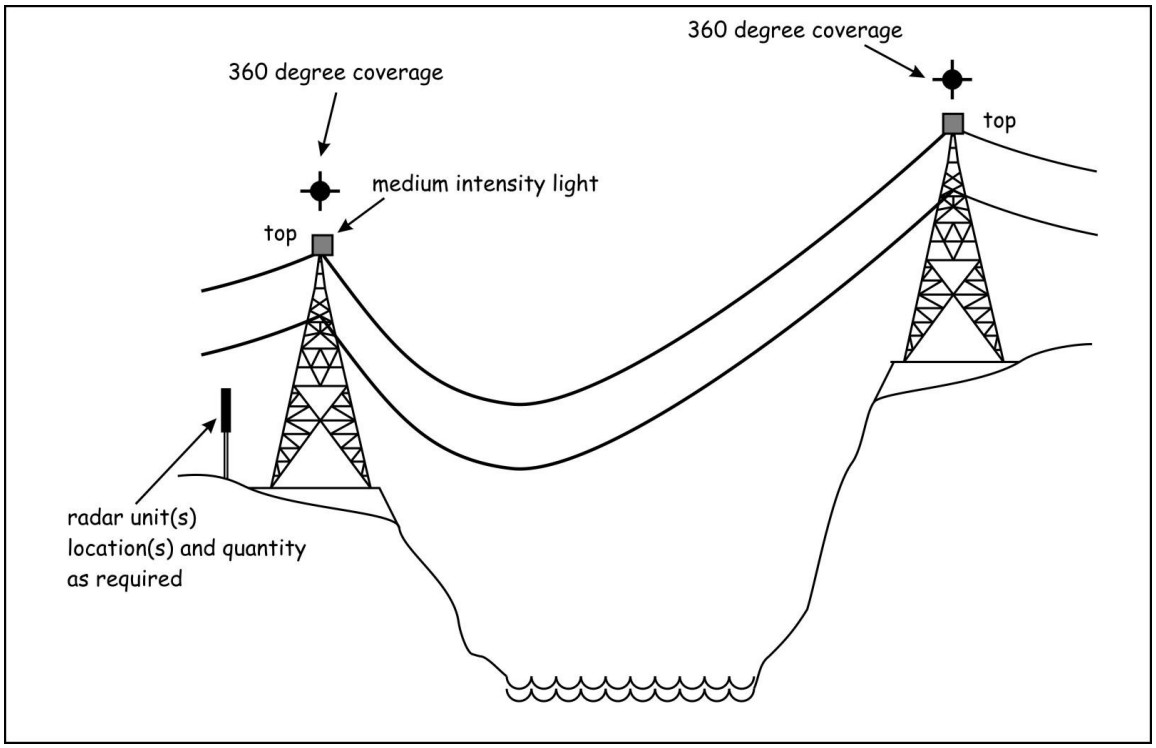

Figure 10-5: Catenary Flashing Lights with ADS

10.9 Site Maintenance / Clearance

The area in the vicinity of the catenary and support structure base should be clear of all items and/or objects of natural growth that could interfere with the line-of-sight between a pilot and the obstacle marking / lighting

~~**Chapter 11 - Marking and Lighting of Moored Balloons and Kites**~~

Chapter 11 - Marking and Lighting of Tethered Objects

11.1 Scope

(1) Chapter 11 governs the marking and lighting of tethered objects including moored balloons and kites.

(2) This chapter does not address tethered objects intended to be released prior to full extension of the tether, such as glider winching operations for which the ground attached tether is exposed in the air for a short period of time.

11.2 Tethered objects less than 150m AGL

11.2.1 Application

A balloon that is 1.8 m or more in diameter or exceeds 3 cubic meters of gas capacity, or a kite weighing more than 2.27 kg are marked and lighted in accordance with the requirements specified in Chapter 11.

11.2.2 Markers

Markers are attached, during daytime, to the mooring lines of a balloon or to the tether cable of a kite in accordance with this section.

(1) **Location**

Markers are displayed at not more than 15 m intervals along the mooring lines of the balloon or the tether cable of the kite, beginning at 45 m from the point of attachment on the ground.

(2) **Characteristics**

Markers required under paragraph (1) are:

(a) rectangular in shape, 0.15 m wide and 3.0 m in length; and

(b) of the following colour patterns:

(i) solid orange, or

(ii) of two triangular sections, one of aviation orange and the other aviation white, combined to form a rectangle.

11.2.3 Lighting

At night, a moored balloon or a kite is equipped with the lighting devices specified in this section.

(1) **Location**

(a) Lights having the characteristics specified in paragraph (2) are located on the top of the object in a fashion as to be viewable from all directions, except that where the dimensions of the object are in excess of 45 m, additional lights of the same type are installed on the top, nose section, tail section, and on the mooring lines or tether cable approximately 5 m below the balloon or kite, so as to define its shape and size; and

(b) Additional lights are equally spaced along the mooring line or tether cable for each 107 m, or fraction thereof, commencing at 90 m AGL.

(2) **Characteristics**

(a) For operations from 90 m AGL to 150 m AGL, red flashing or white flashing lights of 32.5 effective candelas are installed on the moored balloon and on its mooring lines, or on the tether cable of the kite.

~~(b) For operations above 150 m AGL, white flashes of 500 effective candela are installed on the moored balloon and on its mooring line, or on the tether cable of a kite.~~

(3) **Control**

Lighting required on a moored balloon or on a kite is provided with a means of control such as, for instance a photocell, for day and night time operation in accordance with Table 13-1.

11.3 Tethered objects more than 150m AGL

Tethered objects of more than 150m AGL are provided with day and night protection using white high intensity CL-856 lights, or dual white high intensity / red medium intensity lights CL-856/CL-864 lights located and operated as for skeletal objects as detailed in Chapter 7 and Chapter 9

Chapter 12 - Marking and Lighting of Wind Turbines and Windfarms

12.1 Scope

Chapter 12 governs the marking and lighting of a wind turbine and a wind turbine farm.

Information Note 1: The definition of wind farm is based on the premise that the installation of three wind turbines is the first instance for which omission of lighting might be made. Since the exterior wind turbines [on the perimeter] of a wind farm are to be lighted, a grouping of only two wind turbines would require that both be lighted. In the case of three wind turbines lighting of the inner wind turbine may be omitted depending upon spacing.

Information Note 2: The application of these requirements can vary in accordance with the provisions of this Standard depending on terrain features, geographic location, overall layout of the structures, and normal angles of approach.

Information Note 3: The provision of lighting on wind turbines and wind farms should be done in a fashion as to minimize the possibility of bird fatalities and interference with nighttime astronomical study.

12.2 Wind turbines of Total Height Equal to or Less than 150 m

(1) **Marking Requirements - day protection**

(a) For ~~the purpose of Day Protection~~, a single wind turbine and wind turbines of a wind farm, having a solid silhouette, the rotor blades, nacelle and upper 2/3 of the supporting mast are painted a white or an off-white colour.

(b) A windturbines having a lattice-work support mast has the mast painted in bands of orange and white as for skeletal structures.

Information Note: The above specified colours can be found in the RAL colour system as ...

orange - 2009
white - 9010
off-white -7035 (light grey)

(2) **Lighting Requirements - twilight and night protection.** For Night Protection, a single wind turbine and wind turbines of a wind farm are lighted as illustrated in Figure 12-1 and as follows:

(a) For a single wind turbine,

(i) A wind turbine is lighted with use of a CL-864 ~~medium intensity red flashing beacon~~ light unit for twilight and nighttime operation ~~hours~~ for horizontal turbines or a CL-865 light unit for daytime, twilight and nighttime operation for vertical turbines as shown in Figure 12-1.

(ii) The lighting fixtures required under subparagraph (i) are mounted to ensure an unobstructed view by a pilot approaching from all angles of aircraft approach.

(b) For a wind farm;

(i) The group of wind turbines composing a wind farm is indicated to pilots by installation of CL-864 medium intensity red flashing beacons on specified wind turbines on the perimeter of the wind farm.

(ii) The "wind farm indicators" of subparagraph (i) are located so as to define the wind farm perimeter and spaced at a ~~horizontal~~ distance of approximately ~~in the order of~~ 900 m ~~for given directions of aircraft approach.~~

(iii) In addition to the wind farm indicators of subparagraph (ii) the dominant [highest ~~in absolute~~ height AMSL] wind turbine within the wind farm is also required to be lighted. This requirement for lighting is dependent upon the degree of dominance deemed to produce a hazard to air navigation. The Minister may require lighting on more than one inner wind turbine, depending upon the dimensions of the windfarm.

(iv) A tower or other structure within the wind farm, which in being lighted provides the same level of safety, may be used for installation of a wind farm indicator.

(v) Because of the variation in configuration of wind farms, the provision of lighting is also subject to a risk assessment taking into account such factors as the general profile of the group, the location of the wind farm in relation to nearby aerodromes or recognized VFR flight routes, and the anticipated air traffic.
(vi) All indicator lighting provided for a wind farm flashes simultaneously.

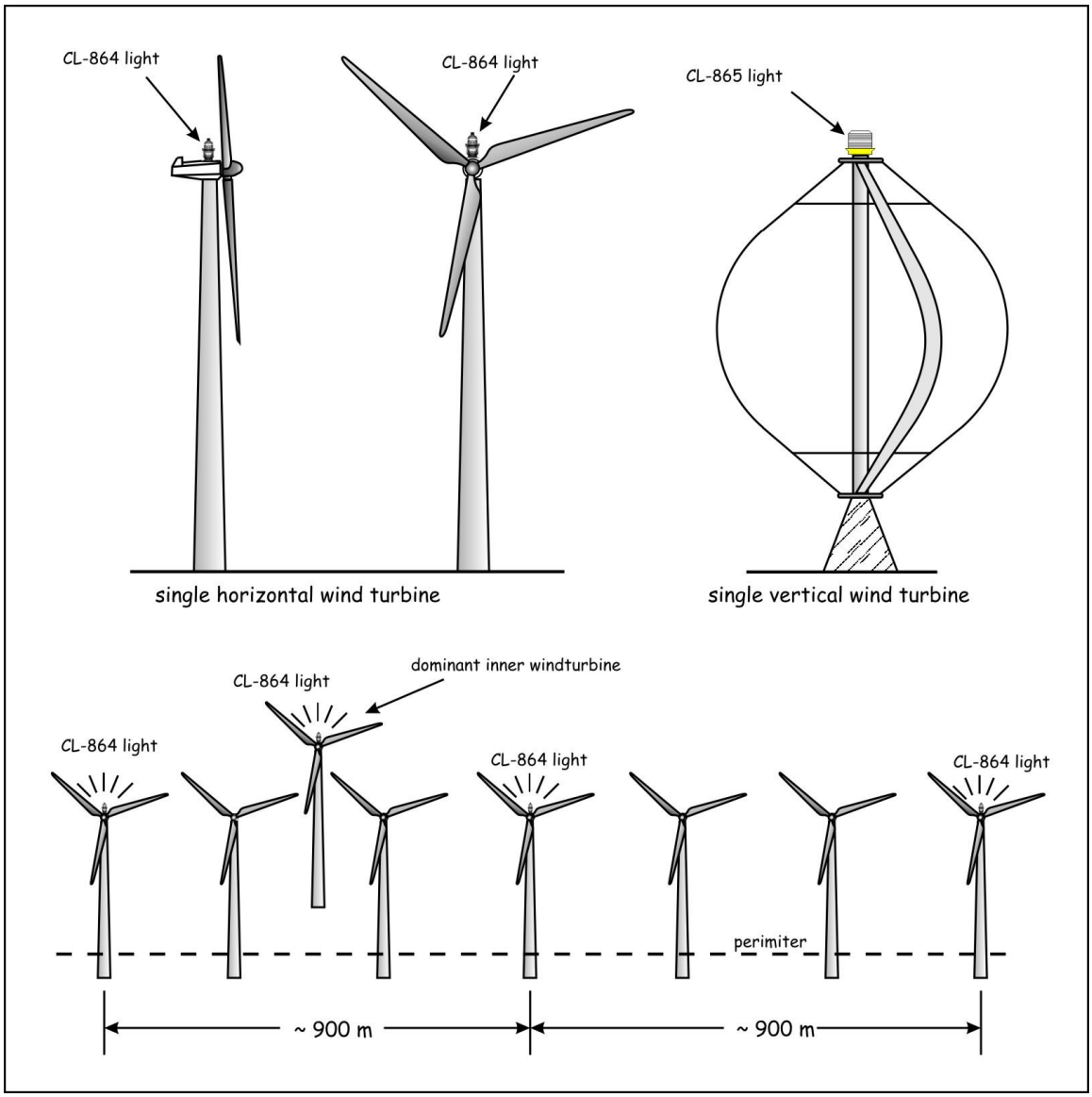

Figure 12-1: Lighting windturbines; heights up to 150m AGL

12.3 Wind turbines of Total Height Exceeding 150 m

~~The provision of marking and lighting for wind turbines higher than 150 m is determined through means of a risk assessment.~~

(1) **Marking Requirements - day protection.** Refer 12.2(1)

(2) **Lighting Requirements.** For wind turbines of 150m to 315m in overall height:
(a) Two CL-864 lights are installed on the nacelle, as illustrated in Figure 12-2 . Only one light operates at a time; the second light serving as backup in case of failure of the operating light. The lights are installed

on top of each other so that the output of operating light is not blocked by the standby light for angles of approach.

(b) At least 3 CL-810 lights are installed for an intermediate level at half the nacelle height and configured to flash at the same rate as the light on the nacelle.

(c) The lights are installed:

(A) in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

(B) as "windfarm indicators" according to 12.2(2)(ii) and (iii).

Information Note. The above standard does not address windturbines of more than 315m. For windturbines of more than 315m of overall height, additional marking and lighting may be required.

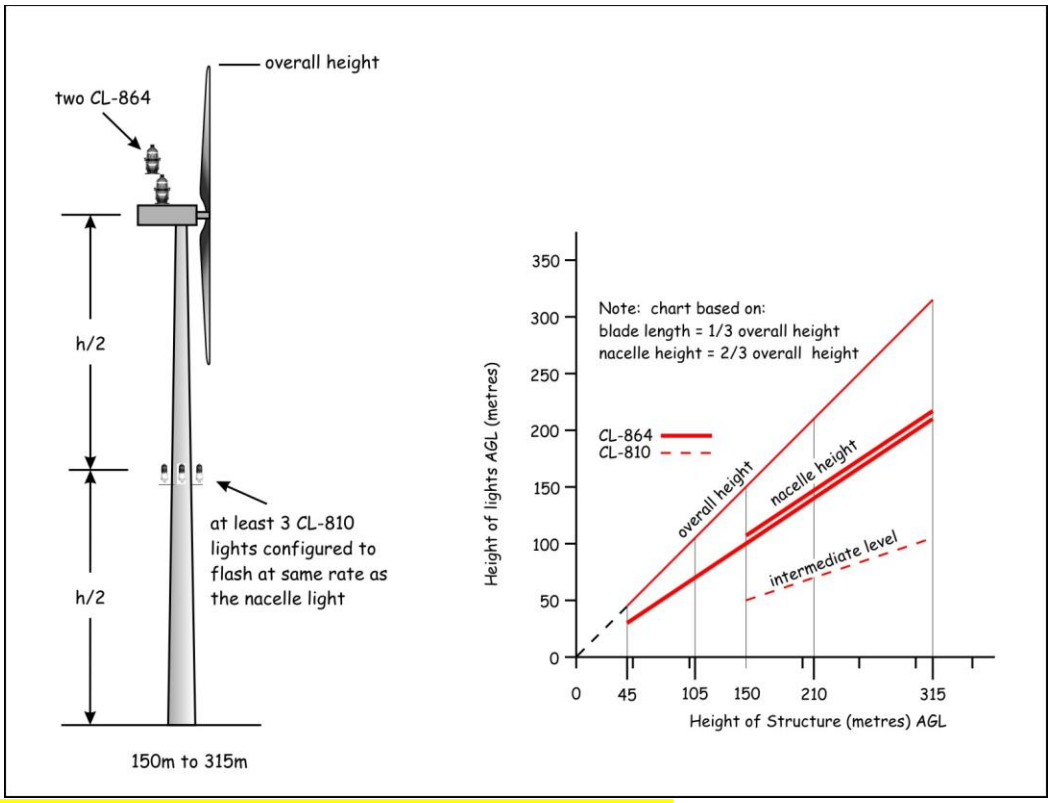

Figure 12-2: Lighting windturbines; heights 150m to 315m

(3) The provision of marking and lighting for wind turbines higher than 315 m is determined through means of a risk assessment.

12.4 Continued Illumination

The lighting provided for a wind turbine or wind farm is so designed such that it can draw power from the electrical grid for continued illumination even though the wind turbine on which it is mounted ceases operation.

Information Note: The above standard is based upon the premise that the lighting of a non-operating wind turbine can be provided with ~~obtain~~ power from the grid when the windturbine itself is not operating to generate power. However, the standard ~~it also~~ recognizes that continued illumination will not be possible should the electrical grid also ~~itself~~ fail.

12.5 Temporary Lighting During Construction

In order to ensure conspicuity of turbines at night during construction, all turbines are lit with temporary lighting once they reach a height of 60m or greater until such time the permanent lighting configuration is turned on. As the height of the structure continues to increase, the temporary lighting is relocated to the uppermost part of the structure. The temporary lighting may be turned off for periods when it would interfere with construction personnel. If practical, permanent CL-864 and CL-810 obstruction lights are installed and operated at each level as construction progresses. At least two CL-810 fixtures are used to light the structure during the construction phase. The lights are positioned to ensure that a pilot has an unobstructed view of at least one light at each level.

12.6 MET Towers (meteorological towers)

MET towers that are used to measure the wind resource available for windfarms may present a hazard to aircraft engaging in low level flight for aerial agricultural application of pesticides and other products. As illustrated in Figure 12-3, MET towers that are 60m or more in height are provided with marker balls on the guy wires near the top of the tower. In addition, the mast of the tower is painted in a banded pattern as stipulated in 3.5(3).

Information Note: It is recommended that MET tower less than 60m in height be provided with balls on the guy wires and the mast be painted in a banded pattern.

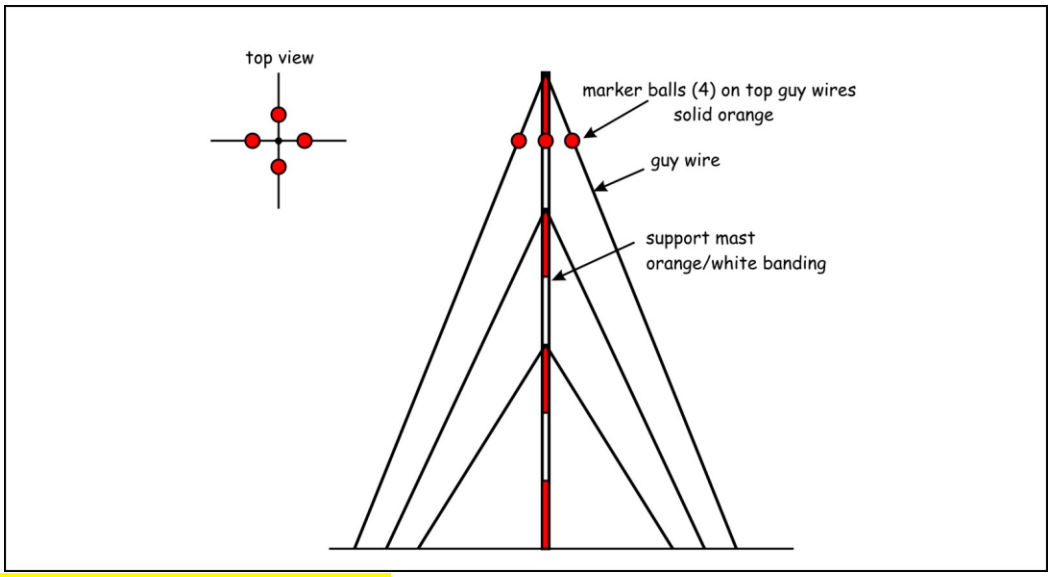

Figure 12-3: MET tower marking

Chapter 13 - Obstruction Lighting Characteristics

13.1 Scope

Chapter 13 governs the overall technical characteristics of obstruction lighting equipment required under this Standard.

13.2 Equipment Specification

The specifications covering electrotechnical requirements of obstruction lighting equipment are contained in Appendix B.

13.3 Photometrics

The photometric output of obstruction light units required under this Standard is in accordance with Table 13-4 for fixed lights and Table 13-5 for flashing lights ~~Table 13-2~~. Figures 13-1 and 13-2 ~~Table 13-1~~ provides an illustration of these photometric requirements.

~~**13.4 Photocell Control**~~

~~In order to have automatic control of obstruction lighting systems, these are provided with a photocell device with settings as shown in Table 13-1.~~

~~**Table 13-1: Photocell Control Settings**~~

~~**Operational transition occurs from – to**~~		~~**at a north sky illuminance of**~~
~~day~~	~~twilight~~	~~600 to 350 lux~~
~~twilight~~	~~Night~~	~~350 to 20 lux~~
~~night~~	~~twilight~~	~~20 to 350 lux~~
~~twilight~~	~~Day~~	~~350 to 600 lux~~

13.4 Photocell Control

(1) Red and white obstruction lighting systems are operated by means of a control device adjusted so the lights are turned on and off and change intensity steps when the northern sky illuminance on a vertical surface transitions through day-to-twilight and twilight-to-night levels according to the tables 13-1 and 13-2.

Table 13-1: Photocell Control Settings for Northsky Illuminance

Operational transition		**Northsky illuminance range**	
from	to	from footcandles (lux)	to footcandles (lux)
day	twilight	60 (645.8)	35 (376.7)
twilight	night	5 (53.8)	2 (21.5)
night	twilight	2 (21.5)	5 (53.8)
twilight	day	35 376.7)	60 (645.8)

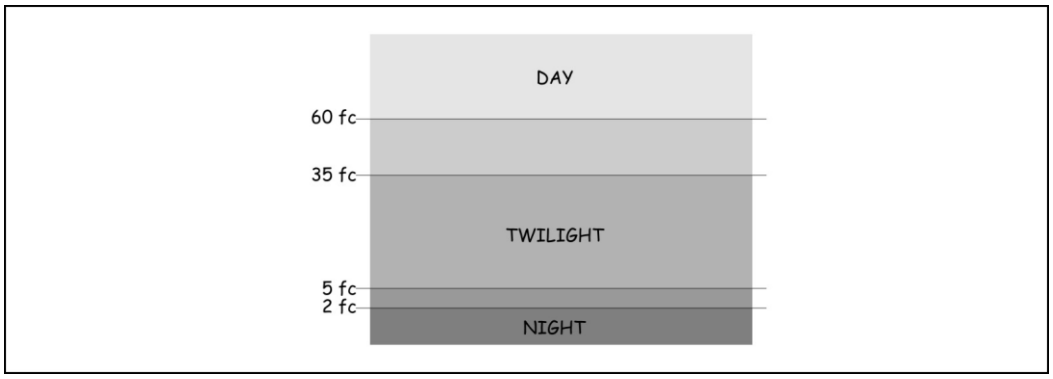

Figure 13-1. Photocell Settings

Table 13-2. Control Settings

		Intensity setting		
Configuration		Day	Twilight	Night
A red lighting system	CL-864 CL-810	off off	1 1	1 1
B HI white	CL-856	3	2	1
C HI white (with L-865 appurtenance light)	CL-856 CL-865	3 2	2 2	1 1
D MI white (no paint)	CL-865	2	2	1
D MI white (with paint)	CL-865	off	2	1
E dual MI white/red (no paint)	CL-865 CL-864 CL-810	2 off off	2 off off	off 1 1
E dual MI white/red (with paint)	CL-865 CL-864 CL-810	off off off	2 off off	off 1 1
F dual HI white/red	CL-856 CL-865 CL-864 CL-810	3 2 off off	2 2 off off	off off 1 1
Catenary Configuration				
S1 MI white,	CL-866	2	2	1
S2 dual MI white/red (no paint)	CL-866 CL-885	2 off	2 off	off 1
S2 dual MI white/red (with paint)	CL-866 CL-885	off off	2 off	off 1
S3 HI white	CL-857	3	2	1
S4 dual HI white/red	CL857 CL-885	3 off	2 off	off 1
S5 red	CL-885	off	1	1

Information note. The premise for lighting control is that where a red lighting system alone is installed, its operation is for twilight and night. Where a dual white/red system is installed, the white lighting is operated in twilight and the red lighting is operated for only nighttime.

~~**Table 13-2: Obstruction Light Photometric Distribution**~~

~~Minimum Intensity (a)(g)~~							~~Intensity (candelas) at given elevation angles when the light is levelled (c)~~				
~~Light Type~~	~~Colour~~	~~Signal type~~	~~day~~	~~twilight~~	~~night~~	~~Vert. beam spread (b)~~	~~- 10º (d)~~	~~- 1º (c)~~	~~± 0º (c)~~	~~+ 2.5º~~	~~+12.5º~~
~~CL810~~	~~red~~	~~fixed~~	~~N/A~~	~~32~~	~~32~~	~~10º~~	~~——~~	~~——~~	~~——~~	~~32 min~~	~~32 min~~
~~CL864~~	~~red~~	~~20-40 fpm~~	~~N/A~~	~~N/A~~	~~2000~~	~~3º min~~	~~——~~	~~50% min 75% max~~	~~100% min~~	~~——~~	~~——~~
~~CL865 (f)~~	~~white (f)~~	~~40 fpm~~	~~20,000~~	~~20,000~~	~~2000~~	~~3º min~~	~~3% max~~	~~50% min 75% max~~	~~100% min~~	~~——~~	~~——~~
~~CL866~~	~~white~~	~~60 fpm~~	~~20,000~~	~~20,000~~	~~2000~~	~~3º min~~	~~3% max~~	~~50% min 75% max~~	~~100% min~~	~~——~~	~~——~~
~~CL885~~	~~red~~	~~60 fpm~~	~~N/A~~	~~N/A~~	~~2000~~	~~3º min~~	~~——~~	~~50% min 75% max~~	~~100% min~~	~~——~~	~~——~~
~~CL856~~	~~white~~	~~40 fpm~~	~~270,000~~	~~20,000~~	~~2000~~	~~3º min~~	~~3% max~~	~~50% min 75% max~~	~~100% min~~	~~——~~	~~——~~
~~CL857~~	~~white~~	~~60 fpm~~	~~140,000~~	~~20,000~~	~~2000~~	~~3º min~~	~~3% max~~	~~50% min 75% max~~	~~100% min~~	~~——~~	~~——~~

~~(a) Effective intensity, as determined in accordance with Appendix B.~~
~~(b) Beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the intensity shown in columns 4, 5 and 6. The beam pattern is not necessarily symmetrical about the elevation angle at which the peak intensity occurs.~~
~~(c) Elevation (vertical) angles are referenced to the horizontal.~~
~~(d) Intensity at any specified horizontal radial as a percentage of the actual peak intensity at the same radial when operated at each of the intensities shown in columns 4, 5 and 6.~~
~~(e) Intensity at any specified horizontal radial as a factor of the lower tolerance value of the intensity shown in columns 4, 5 and 6.~~
~~(f) In the case of rotating type CL-865, one-third of the flash display is red in colour. e.g. WWRWWR~~
~~(g) For flashing lights a tolerance on the nominal of ±25%.~~

Table 13-3. Characteristics of obstacle lights

Light Type	Colour	Signal type	flash rate (fpm)	Nominal intensity (cd)	Intensity Settings	Light Distribution Table
LI CL-810	red	fixed		32	1	Table 13-4
MI CL-865 (e)	white	flashing	40	20, 000	2	Table 13-5
MI CL-864	red	flashing	20–40	2000	1	Table 13-5
HI CL-856	white	flashing	40	270,000	3	Table 13-5
HI CL-857	white	flashing	60	140, 000	3	Table 13-5
Catenary MI CL-866	white	flashing	60	20, 000	2	Table 13-5
Catenary MI CL-885	red	flashing	40	2000	1	Table 13-5

LI = low intensity MI = medium intensity, HI = high intensity

Table 13-4. Minimum Intensity and light distribution for low-intensity obstacle lights (Figure 13-2)

		Vertical range (degrees)	
Light Type	Minimum intensity (a)	Lower limit	Upper limit
CL-810	32 cd	+2.5°	12.5°

Note:

(a) 360° horizontal.

Table 13-5a: Minimum Effective intensities of flashing lights (a) (Figure 13-3)

		Vertical elevation angle **(b)**		Vertical beam spread **(c)**	
1	2	3	4	5	6
Light Type	Nominal intensity	0° 0.75*[2]	-1° 0.5*[3]	Beam spread	Intensity 0.5*[3]
CL-856	270,000	200,000	100,000	3°	100,000
CL-857	140,000	100,000	50,000	3°	50,000
CL-864	2000	1500	750	3°	750
CL-865 **(e)(f)**	20,000	15,000	7500	3°	7500
CL-866	20,000	15,000	7500	3°	7500
CL-885	2000	1500	750	3°	750

Recheck numbers

Table 13-5b: Recommended maximum effective intensities of flashing lights (a)(d) (Figure 13-3)

		Vertical elevation angle (b)			*Vertical beam spread (c)*	
7	*8*	*9*	*10*	*11*	*12*	*13*
Light Type	*Nominal intensity*	*0° 1.25*[8]*	*-1° 0.75*[3]*	*-10° 0.03*[9]*	*Beam spread*	*Intensity 0.5*[3]*
CL-856	*270,000*	*337,500*	*150,000*	*10,125*	*7°*	*100,000*
CL-857	*140,000*	*175,000*	*75,000*	*5250*	*7°*	*50,500*
CL-864	*2000*	*2500*	*1125*	*75*	*N/A*	*N/A*
CL-865 (e)(f)	*20,000*	*25,000*	*11,250*	*750*	*N/A*	*N/A*
CL-866	*20,000*	*25,000*	*11,250*	*750*	*N/A*	*N/A*
CL-885	*2000*	*2500*	*1125*	*75*	*N/A*	*N/A*

Notes:
(a) 360 degrees horizontal, except CL-857 which may have 180 degrees coverage for the middle and bottom lights on the support structures of catenaries. Effective intensity, as determined in accordance with Appendix B.
(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 is equal to 50% of the lower tolerance value of specified intensity; column 4.
(d) Maximum intensities are recommended. Exceeding the maximum may result in residential complaint.
(e) In the case of a rotating type CL-865, one-third of the flash display is red in colour. e.g. WWRWWR
(f) In the case of a rotating type CL-865, the intensity of the red flash is at least 0.15 of the white flash

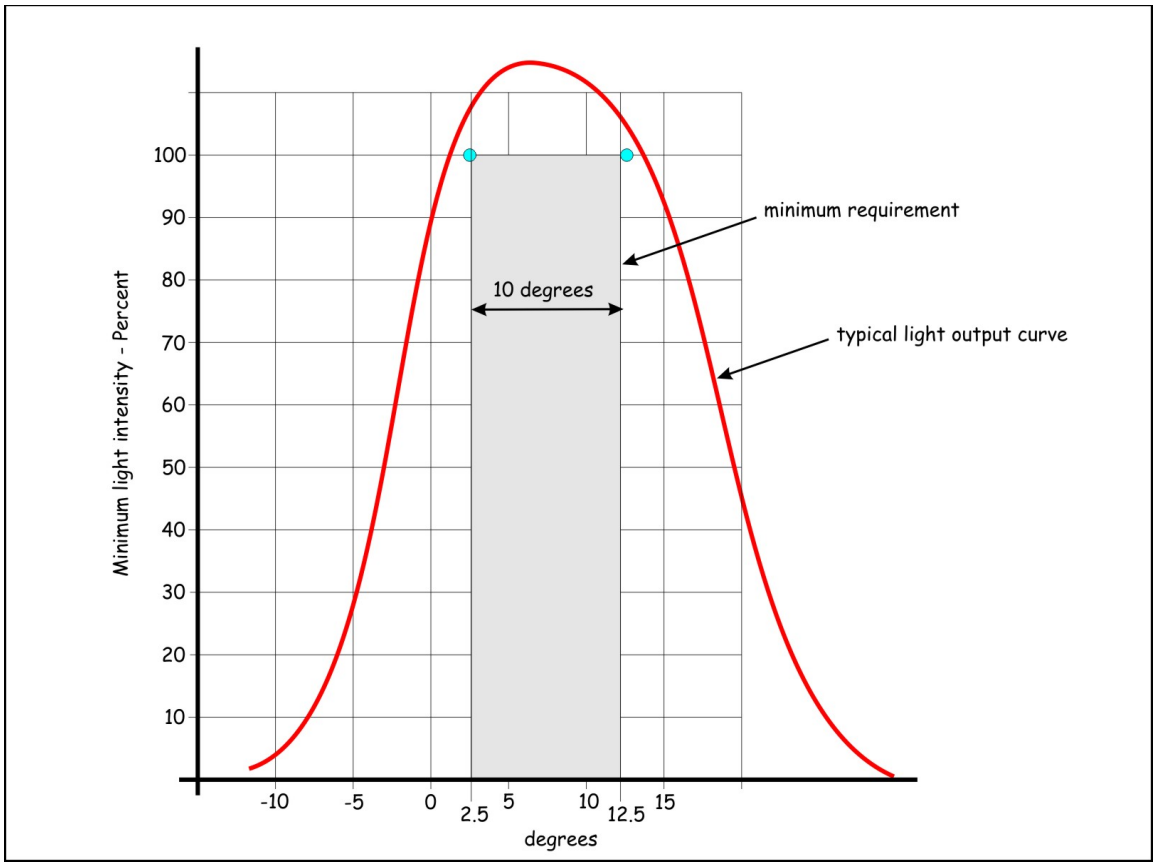

Figure 13-2. Low intensity photometric requirement

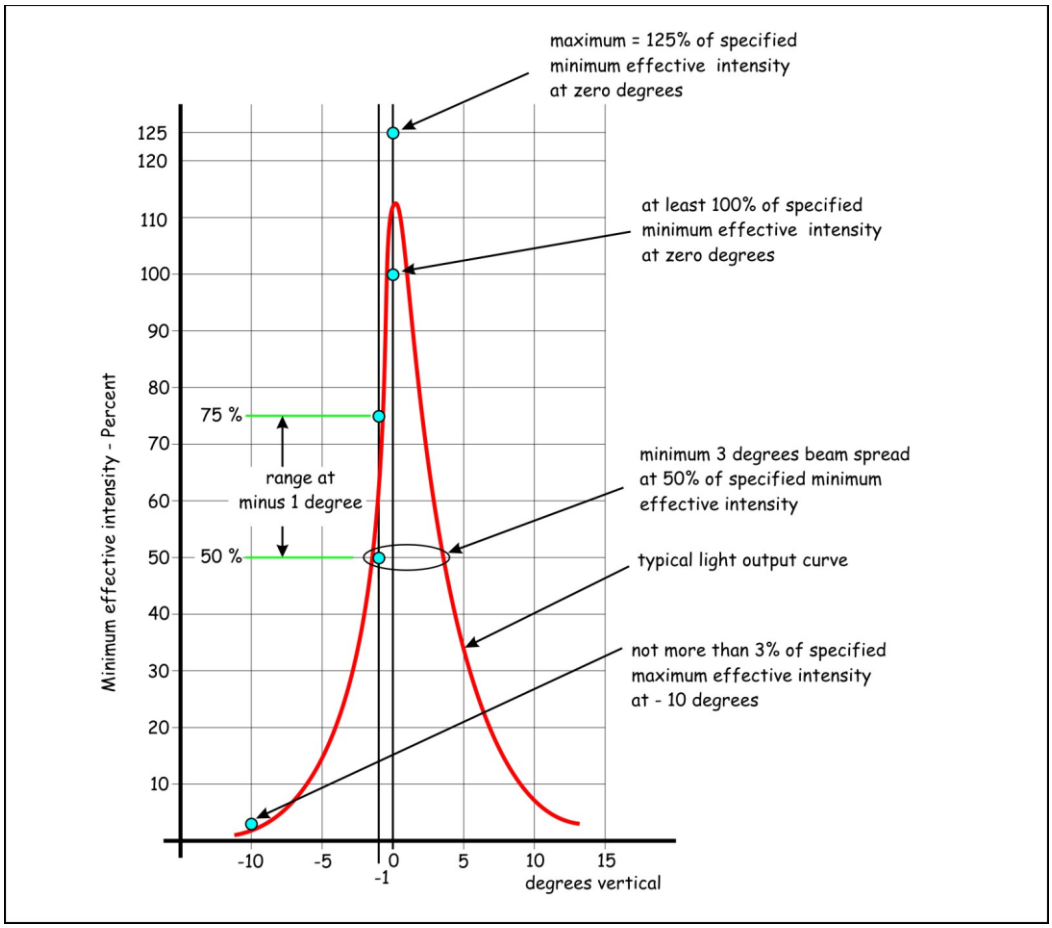

Figure 13-3. High and medium intensity flashing photometric requirement

Chapter 14 - Maintenance

14.1 Scope

Chapter 14 governs the maintenance of marking and lighting required under this Standard.

14.2 Marking and Markers

(1) The surfaces of a building, structure or object required to be marked with paint, are repainted when the colour changes noticeably or when its effectiveness is reduced by scaling, oxidization, chipping or layers of contamination.

Information Note: In-Service Aviation Orange Color Tolerance Charts are available from private suppliers for determining when repainting is required. The colour should be sampled on the upper half of the structure, since weathering is greater there.

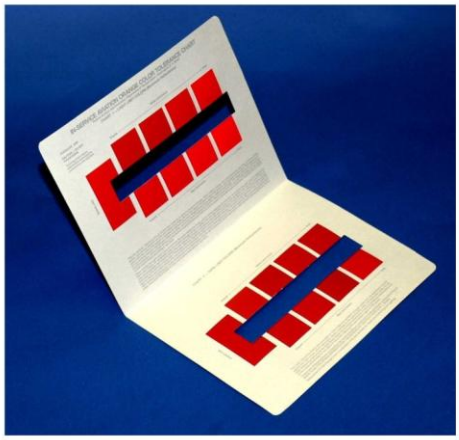

Figure 14-1. In-service aviation orange color tolerance chart

(2) Powerline markers are inspected at least once a year to verify presence and continued visibility.

14.3 Lighting

(1) **Operating Voltage**
To ensure proper candela output:

(a) for light units with incandescent lamps, the voltage provided to the lamp socket shall be within ± 3 percent of the rated voltage of the lamp; or

(b) for light units with strobe [capacitor discharge] lamps, the input voltage to the power supply shall be within ±10 percent of rated voltage of the power supply.

(2) **Lamp Replacement**

(a) A lamp in a light unit is replaced immediately upon failure or after being operated for not more than 75 percent of its rated life.

(b) A flashtube in a light unit is replaced:

(i) immediately upon failure, or

(ii) when the peak effective intensity falls below specification limits, when the fixture begins skipping flashes or at the manufacturer's recommended intervals, whichever occurs first.

(3) **Fixture Lenses.** Owing to the effects of harsh environments, a beacon lens is visually inspected for ultraviolet damage, cracks, crazing, dirt build up or similar forms of degradation, to ensure that the required certified light output has not been adversely affected.

14.4 Removal of Obscuring Effects

Regular inspection takes place and remedial action undertaken to ensure that effects, such as the growth of vegetation, do not obscure the pilot's view of any portion of marking or lighting displayed pursuant to this Standard.

Chapter 15 - Aircraft Detection System (ADS)

15.1 Scope

(1) Chapter 15 governs Aircraft Detection Systems (ADS) which are used to turn on obstruction lighting systems upon detection of an approaching aircraft. The system is sensor ~~radar~~ based and can detect and analyze the flight path [position, altitude, heading and ground speed] of an aircraft so as to determine the possibility of potential collision with an object. If the flight path is such that the aircraft may impact the obstacle, then the obstacle lights are turned on and an ~~a later~~ audio signal may be ~~is~~ transmitted. The purpose of the system is to enable the lighting to be off when not needed [absence of aircraft] and thereby to reduce energy consumption, and minimize cause for complaint from local residents ~~glare to the public~~.

(2) The means of detection is not dependent upon equipment on the aircraft [e.g. a transponder]

15.2 Impact Boundary

(1) The impact boundary is a 3-dimensional boundary around the obstacle approved by the Minister, so as to establish the distance [in terms of seconds] from the location of the detected aircraft to a point of impact on this boundary.

(2) The impact boundary is at a horizontal distance of 30 m to 60 m ~~to 300 m~~ from the actual physical sides of the obstacle, as shown in Figure 15-1.

Information note: An impact boundary for a catenary is shown in Figure 15-1. Different shapes of impact boundary may be required for different obstacles. In the case of lengthy or large area objects, more than one ADS sensor ~~radar~~ may be required.

(3) In vertical dimension, the impact boundary extends 60 m above the highest portion of the obstacle.

15.3 Operation

(1) The system has two primary functions: to turn on the obstacle lights and to emit an audio signal. These functions are performed with respect to the detection of the aircraft within a specified minimum flight time to the impact boundary for both a heading directly towards the impact boundary as well as a potential manoeuvre towards the impact boundary.

(2) The system has the following minimum timings for light and audio signal activation with respect to the speed of the aircraft and time from the impact boundary:

Aircraft speed (knots)	Aircraft speed (metres/second)	Time to ~~from~~ Impact Boundary (seconds)
90	46.3	30
120	61.7	30
165	84.9	30
180	92.6	30
250	128.6	~~20~~ 30

(3) **Potential Manoeuvre to Impact Boundary.** The following addresses the case of aircraft that are not on a direct flight path to impact, but have the potential for impact.

(a) The ADS detects and causes light and audio signal activation per 15.3.2 for aircraft flying in the horizontal plane that would have a potential of impact if it were to conduct a turning manoeuvre of up to 2g. Refer to Figure 15-3.

(b) The ADS detects and causes light and audio signal activation per 15.3.2 for aircraft flying in the horizontal plane that would have a potential of impact if it were to conduct a descent of rate of up to 2.5m/s

[500 ft/minute]. Refer to Figure 15-3.

(4) **Lighting**

(a) Once the lighting is activated upon aircraft detection, the lighting is maintained on for a period of at least 60 seconds.

(b) The lighting for use with ADS is of a design such that it will provide full intensity within 2 seconds of activation.

(5) **Audio Signal**

(a) The provision of an audio signal is required for catenary crossings where obstacle lighting is on the support structures. The provision of an audio signal for extensive objects such as a windfarm is determined on a site specific basis.

(b) ~~(a)~~ The audio signal consists of a 3 note chime followed by a worded message indicating the type of obstacle as determined locally. For example, for a catenary crossing, the term "power line" may be used. The signal is repeated a total of 6 times for slow speed aircraft and 3 times for high speed aircraft [>250 knots], for a total duration of 12 seconds and 6 seconds respectively.

(c) ~~(b)~~ The audio signal is limited in range so as to not interfere with other non-ADS broadcasts. The limitation of range is tested using standard General Aviation VHF radio and antenna equipment while the ADS VHF transmitter is transmitting a continuous test signal, range limit is where the perceived signal quality comes below level 4.

Information note 1: A limited range represented by a volume of space defined by a cylinder centred on the ADS unit with a radius of 7 km and height of 1.8 km, is recommended.

Information note 2: In the radio terminology, the quality of the radio signal is rated on a scale from 1 through 5, where 1 is the worst (unreadable) and 5 is best. A quality of 4 is fully readable, when below 4 the audio signal is degraded below an acceptable level.

(d) ~~(c)~~ The audio signal is broadcast simultaneously with light activation on multiple frequencies in the VHF band over the range of 118 to 136 MHz. The frequencies are selected as appropriate for local requirements.

(6) **Warning Zones**

Information note: The ADS may be considered to establish "warning zones" around the obstacle based upon the timing ~~timings~~ for light activation and audio signal transmission in relation to the impact boundary. The warning zone, therefore, extends outward from the impact boundary to the detected aircraft. Since light activation and transmission of the audio signal [if provided] occur simultaneously, the audio warning zone and the light activation warning zone are equal in dimension.

(a) If the aircraft enters the audio signal warning zone, an audio signal is transmitted. If the aircraft remains within this zone no additional audio signals are provided. A new signal will be provided, if the aircraft leaves the zone and then re-enters.

(b) If the aircraft enters the light activation warning zone, the lights are turned on and will continue to be illuminated for the period specified in paragraph 15.3.4. If the aircraft remains within this zone beyond the specified period, the lights will turn off. The lights will be re-activated, when the aircraft leaves the zone and then re-enters.

(7) **Frequencies**

(a) Audio signal radio broadcasts comply with applicable Industry Canada guidelines and permit requirements.

(b) If radar is used, the ~~The~~ radar frequencies are selected so as to not cause interference with other radar operations.

15.4 Monitoring

The ADS has continuous electronic monitoring to detect failure of the major components.

(a) Sensor ~~Radar~~ or Communications Failure: The occurrence of failure of the sensor ~~radar~~ or of the communication link to the lights cause the lighting to be turned on continuously, the audio signal deactivated and an alarm given to a 24 hour staffed station. There is provision for immediate issuance of a NOTAM from this station. The communication status and operational status of the system are confirmed at least once every 24 hours.
(b) Obstruction Lights Failure: If a light outage occurs, the audio warning function remains active, the monitoring station is notified and a NOTAM issued. Corrective action is taken as soon as possible to restore the lights ~~light~~.

15.5 Self Test

Unless the system has been activated at least once within a 24 hour period by aircraft, the system is activated for self test at least once within a 24 hour interval to verify the operational status.

15.6 Sensor ~~Radar~~ Unit Backup Power Supply

The sensor ~~radar~~ unit is provided with a battery backup supply having a capacity for at least 24 hours of operation, to enable communication to turn on the lights in case of external power supply failure ~~to the lights~~.

15.7 Submission of Application for Use

The design and function of each control device is described in the ADS application. The control device description includes: functionality, selectable features, program modification, maintenance actions, failure/monitoring provisions and any reporting functions. The reportable functions are described and the methodology detailed for accumulating information.

15.8 Commissioning Test

The ADS installation is subject to a commissioning test to verify:
(a) the required performance of the system,
(b) absence of any interferences of a sensor unit based upon ~~the~~ radar ~~unit~~ with other radars in the area, and
(c) that the audio does not present a hazard to other aircraft communications not in proximity to the obstruction hazard.

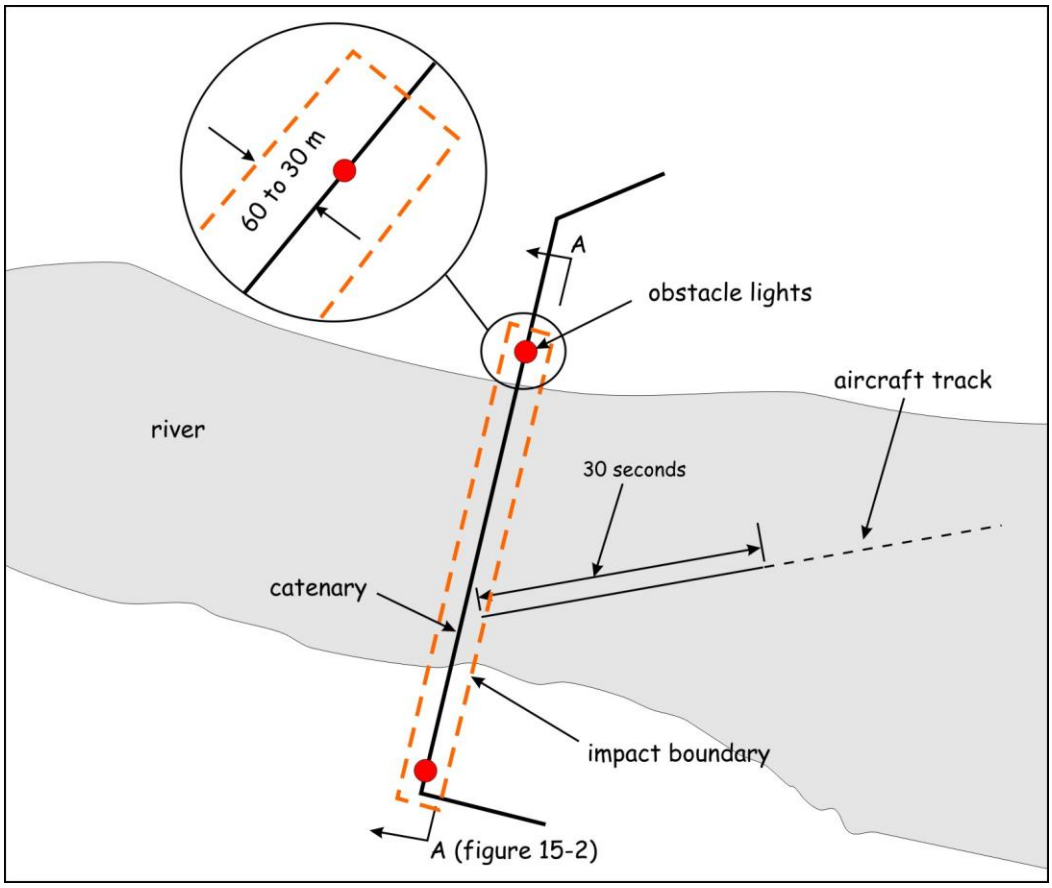

Figure 15-1: Catenary Crossing - plan view

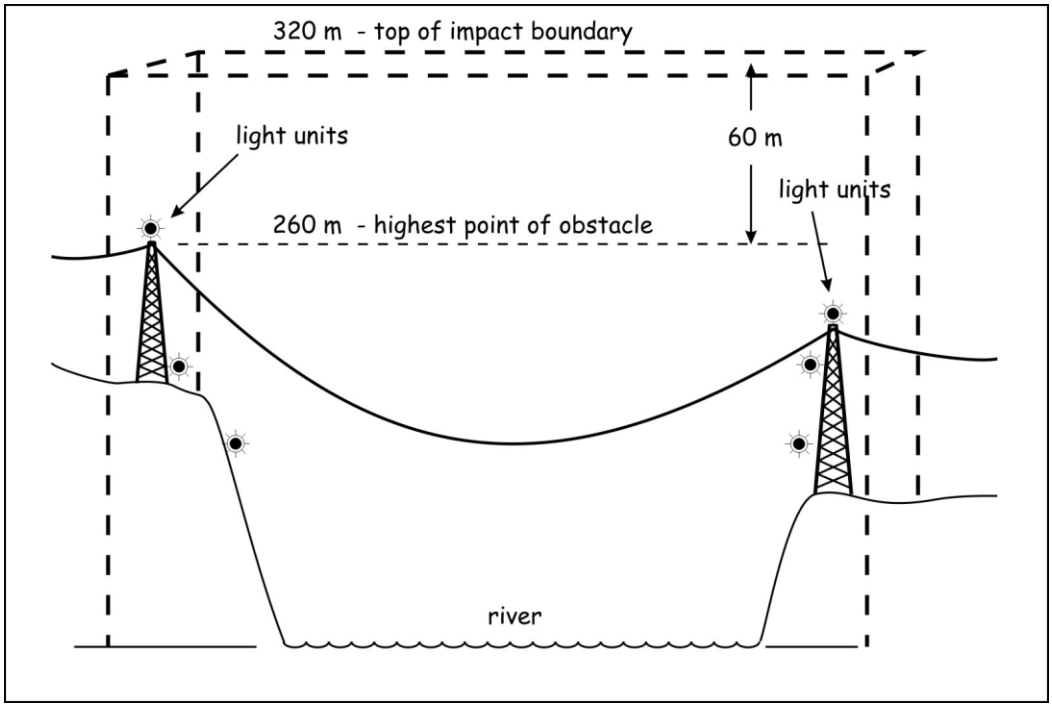

Figure 15-2: Catenary Crossing - profile view

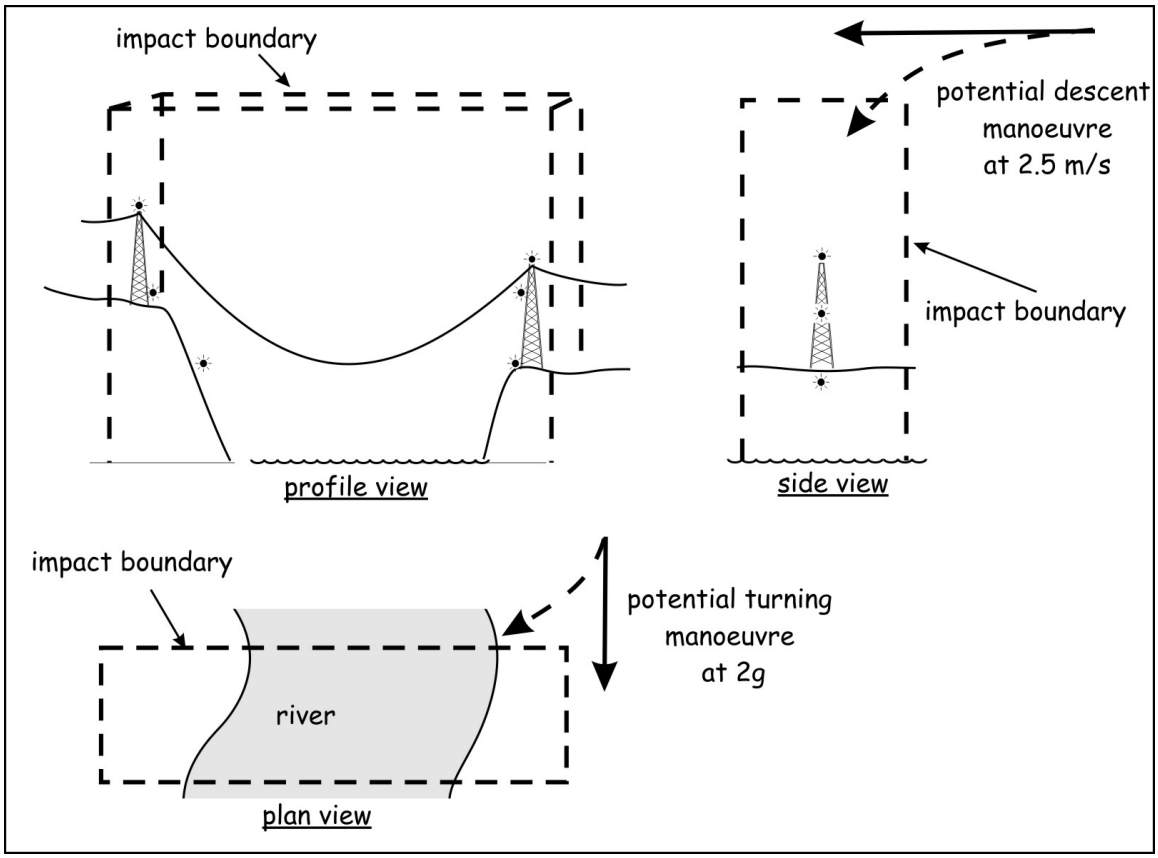

Figure 15-3: Potential Turning/descent Manoeuvres