

AERODROMES PANEL (AP)

VISUAL AIDS WORKING GROUP (VAWG)

FIFTH MEETING

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Agenda Item 6: Use of light emitting diode (LED) technology in visual aids

TAXIWAY CENTRELINE PERFORMANCE AND LINE LIGHTING

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SUMMARY

Line lighting [closely spaced LED elements in a strip-form of light unit] has potential for application in aerodrome lighting. In contrast to conventional point source lighting, around which Annex 14 has been developed, each strip of line lighting contains within itself the functional aspect of directionality. For this reason, under low visibility conditions it may be beneficial in enabling guidance within a much lesser visual segment.

It is proposed that a first step towards consideration of line lighting would be review of the underlying performance criteria for taxiway centreline photometric specification.

1.0 INTRODUCTION

1.1 As the technology advances, new forms of lighting using LED sources are coming on the market. One such form is that of line lighting which has found some acceptance for roadway applications. It also has been used for apron applications on airports.

1.2 Please note that although this paper is written with reference to a particular form of line lighting, this not to suggest that similar directionality could not be provided by installing numerous conventional point source light units at close spacing. This, however, would require a redesign of the fixture itself as the present 300mm [12"] lights if placed too close together might be an issue with structural pavement engineers.

The issue here is not in the packaging, but rather of multiplicity which renders directionality at each individual light station. It should also be kept in mind that conventional light units are also being designed with LED sources, so the interest of this paper is specific to LED technology.

2.0 DISCUSSION

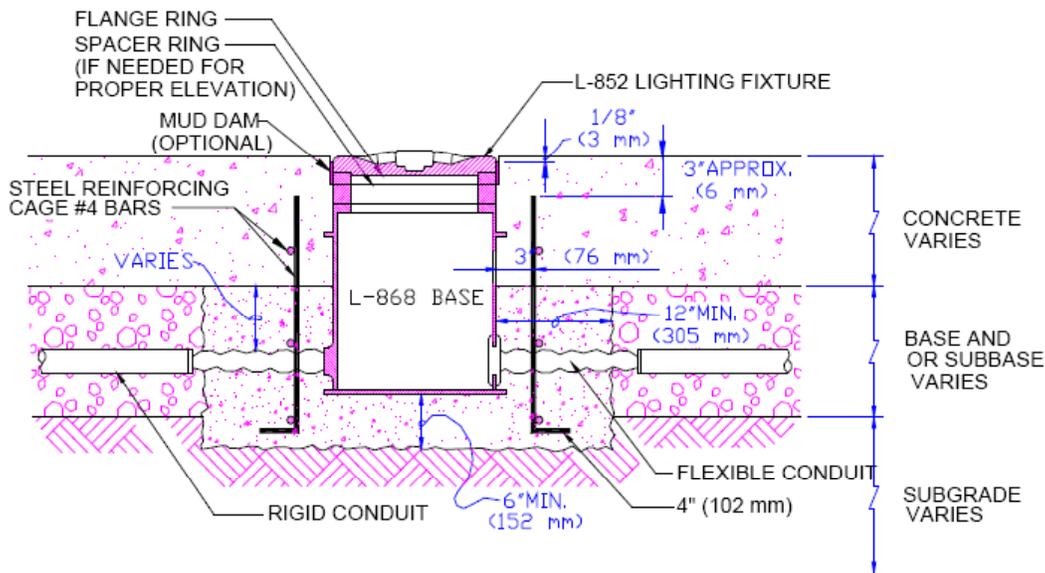
2.1 Essentially all types of lighting on the airfield are intended to provide linear directional instruction to the pilot, even though their specification in Appendix 2 of Annex 14 is in the form of a distribution diagram of a single point source element. Runway and taxiway edge lighting have a similar functionality in that they give indication of limits within which the pilot is to maintain the aircraft.

Taken together, runway and taxiway centreline lighting most certainly gives directional instruction as to a path which the pilot is to follow.

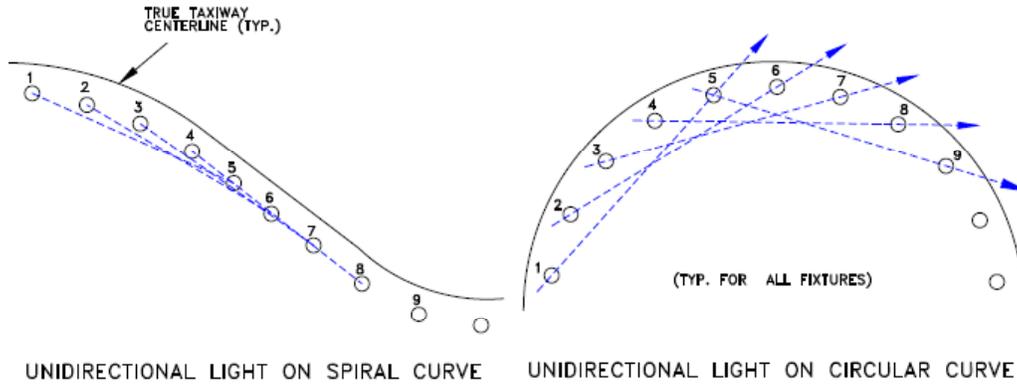
Inset stopbar and intermediate taxiway intersection lighting do not provide direction, yet they are inherently lines provided on the pavement.

2.2 Line lighting, as is the focus of the paper does not provide something new in concept. What it does present is a new alternative means of display which may be of advantage both to the airport and to the pilot.

2.3 With respect to the airport ... that is to the airport owner/operator ... there may be cost advantages, since the line light is installed in a sawcut rather than to use receptacles or deep cans that necessitate coring into the pavement. The deep can, in particular, requires special preparation not only of the pavement, but also provisions for retention in the subgrade. All of this is at significant cost. The figure below shows a typical installation detail of a deep can used for inset lighting.

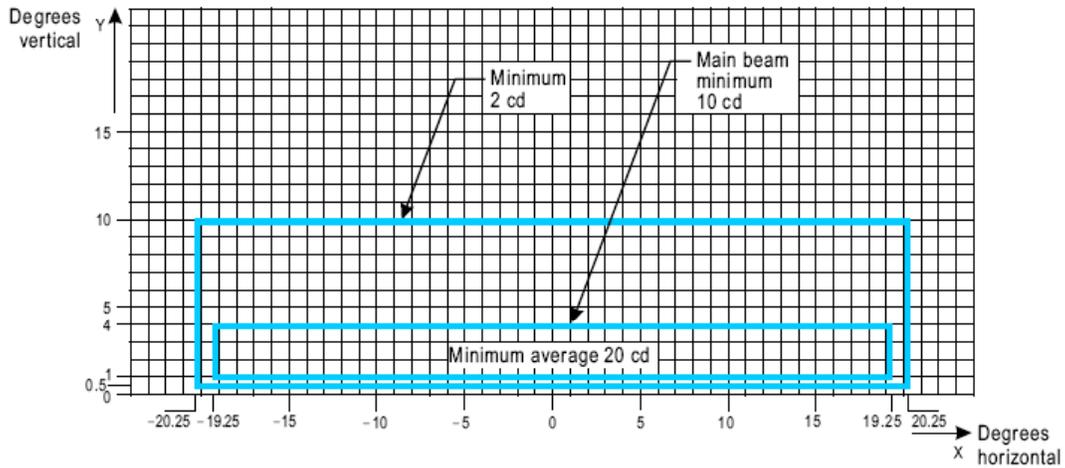


2.4 With respect to the pilot ... point source inset lights are aimed so as to be optimally seen at a distance which includes four light spacings. This is intended to give a directionality of at least three lights with allowance for the aircraft cutoff angle. This requires that the fifth light unit be of an intensity sufficient for the anticipated visibility conditions.

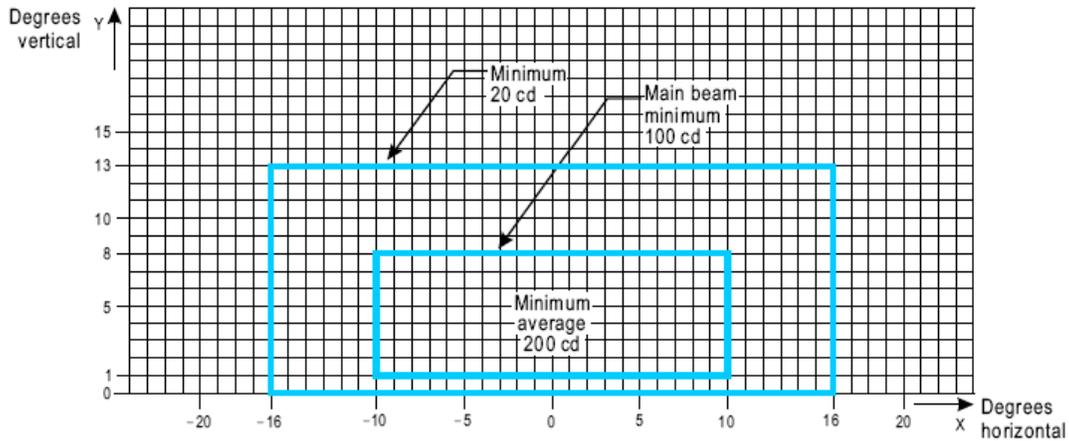


2.5 The photometric specification of these point source light units are contained in Appendix 2 of Annex 14.

In the case of taxiway centreline lighting on curves at 15m spacing and RVR greater than 350m the following isocandela diagram of Figure A2-15 is given



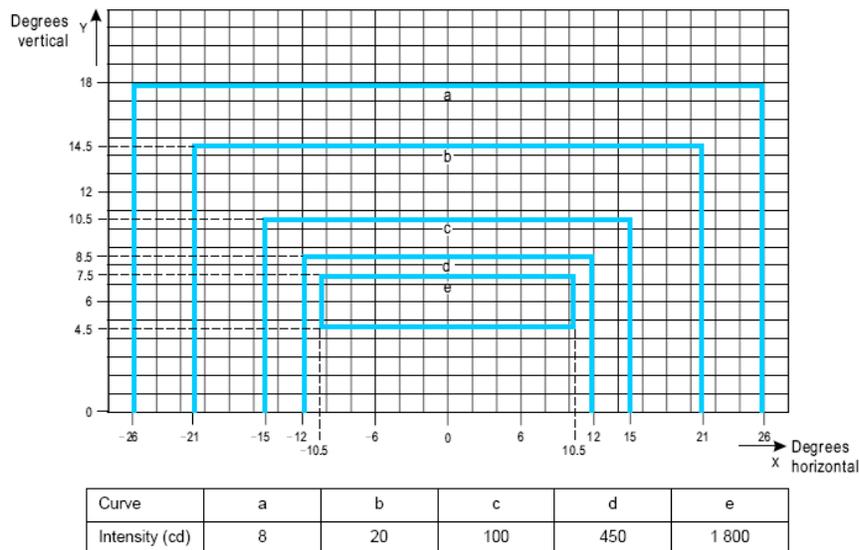
In the case of taxiway centreline lighting on curves at 15m spacing and RVR less than 350m the following isocandela diagram of Figure A2-16 is given



Appendix 2 presently incorporates a second set of photometric diagram for what is said to be situations for which "higher intensities are required". This is referenced from 5.3.16.10 ...

5.3.16.10 Recommendation.— *Where taxiway centre line lights are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, taxiway centre line lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.*

Note.— *High-intensity centre line lights should only be used in case of an absolute necessity and following a specific study.*



But is ICAO saying here that "ground movements at a certain speed in very low visibilities or in bright daytime conditions" cannot be accomplished with the lights presented in Figures A2-12 to A2-14?? To an extent, that would seem to be the case. If the lights of figures A2-12 to A2-14 are specified for use in RVR less than 350, what is the justification to suggest that they cannot be

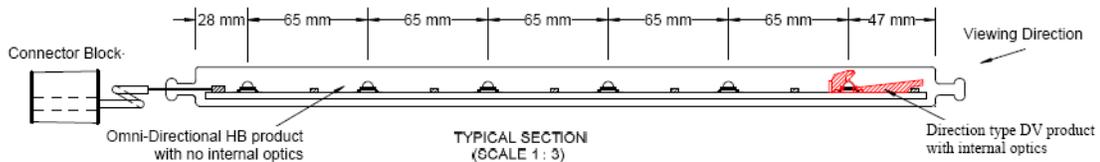
used at "very low visibilities". Why is it now necessary that a 9-fold increase of intensity be provided?? Just because it is an "advanced surface movement guidance and control system", how does that change the usability of lights which are already stated in 5.3.16.8 as useable for less than 350m RVR??

There may be justification in this for "bright daytime conditions". But presently specified lights of article 5.3.16.8 are being used during daytime. So again there would seem to be a contradiction.

And further, why are the figures A2-17 to A2-19 different in presentation than those of A2-12 to A2-16?? Does the advent of an advanced surface movement guidance and control system change the manner in which lights are seen by the pilot?? Figures A2-17 and A2-18 have the light unit setting at 6 degrees vertical. This may be necessary for closer view of the lights. Yet in Figure A2-19 the beam centre is brought down to 4.25 degrees vertical which is less than that of the 4.5 degrees in Figure A2-12/13 and the 5.5 degrees of Figure A2-14.

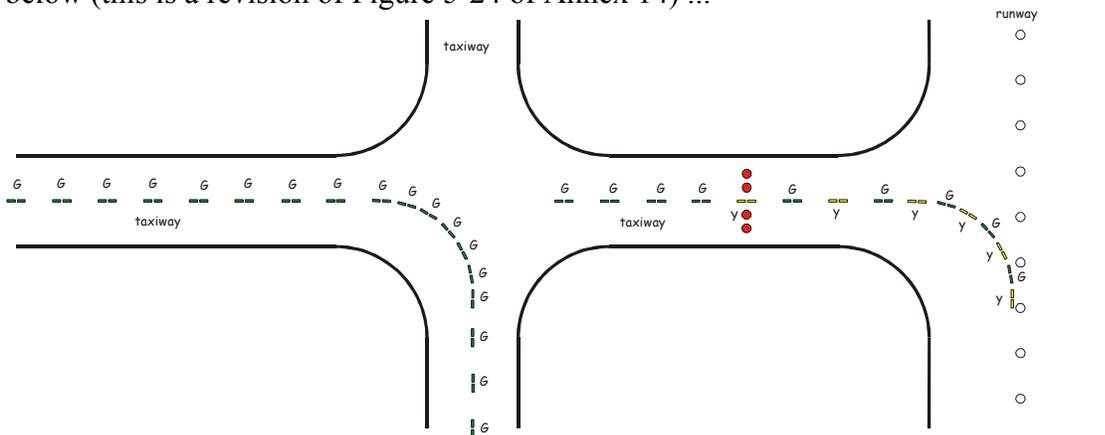
It is not the purpose of this paper to suggest that the figures of Appendix 2 are inadequate. Our purpose is to emphasize the need for a description of the underlying photometric criteria. If this rationale is lacking for figures A2-12 to A2-16, it is even more so the case for figures A2-17 to A2-19.

2.6 For line lighting and taxiway centreline lighting, the light strip would be as shown in profile below.



This "light strip" is 40cm long and could be placed in any combination on the pavement.

2.7 The application of these light strips for taxiway centreline lighting would be as shown below (this is a revision of Figure 5-24 of Annex 14) ...

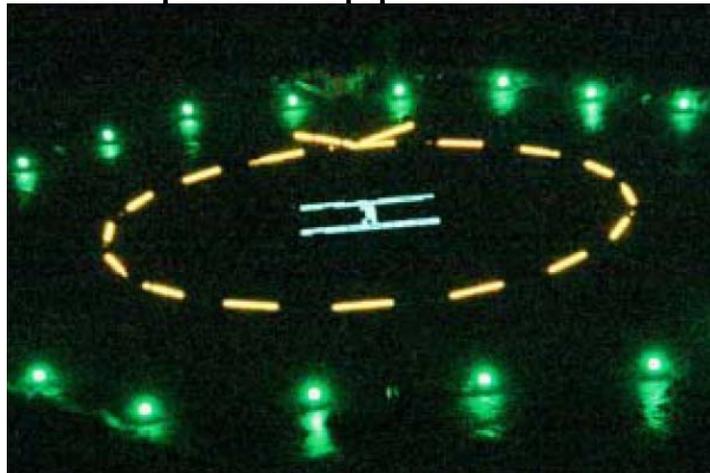


2.8 There may be a problem with the application of line lighting for runway exits where presently the Annex 14 stipulates a unidirectional colour coding. A question could be raised, however, as to why it is necessary that the pilot entering a runway should only see green signals.

2.9 Other Applications

We do not as yet have installations specific to low visibility application at airports, for reason of the lack of performance criteria [thus the reason for this paper], however, line lighting has been considered for heliport application and is being trial evaluated for aprons .

Enhancing Offshore Helideck Lighting – Onshore Trials at Norwich Airport --- CAA paper 2006/03



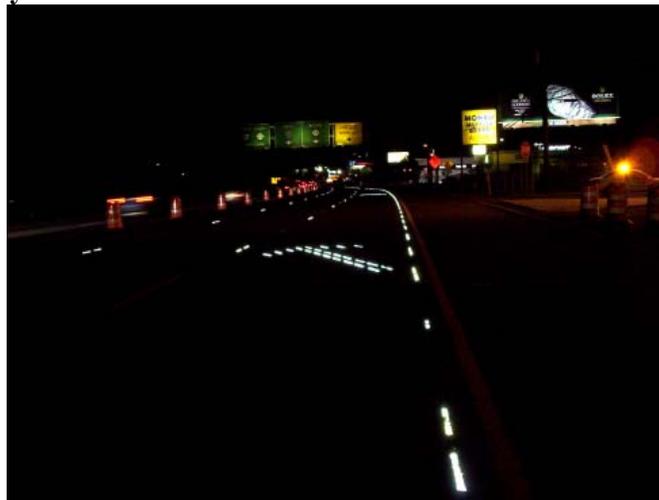
Anchorage International Airport - Trial of apron lighting



Schiphol International Airport - Trial of apron lighting



New Jersey - Roadway Trial



3.0 CONCLUSION - PROPOSAL

3.1 The lighting is specified in Annex 14 Appendix 2 by means of isocandela diagrams that give the minimum required output of conventional "point source" lighting.

3.2 New forms of lighting are being developed such as the "line lighting" of this paper. However, there is an impasse to consideration of possible use of these new forms, since we do not have available a description of the underlying performance criteria for the lighting in Appendix 2. Such a description is essential if we are to proceed from point source designs to new innovation.

3.3 With respect to taxiway centreline lighting, Appendix 2 is not consistent in its use of isocandela diagrams. If there is an underlying rationale for figures A2-12 to A2-16, then what is the rationale behind the figures A2-17 to A2-19??

3.4 The Aerodrome Design Manual, Part 4, article 4.6 provides some information on the design of taxiway centreline lighting, but this is minimal and does not help in fully understanding the criteria of figures in Appendix 2. In regard to intensity, article 4.6 simply refers back to the diagrams of Annex 14.

3.5 The bottom line is that in evaluating new technology, we can't get there from here. That is, from the photometrics now provided in Annex 14.

3.6 It is therefore proposed that the whole of taxiway centreline lighting specification be revisited in order to identify the rationale or performance criteria which underlies the present photometric diagrams in Appendix 2.

3.7 The result of this work might be used to update the ADM, Part 4.

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