International Civil Aviation Organization

The Fourth Meeting of the Asia/Pacific Aerodrome Design and Operations Task Force (AP-ADO/TF/4)

Hybrid Meeting, Chiang Rai, Thailand, 10 to 13 January 2023

Agenda Item 2: Planning, Design and Construction of Aerodromes

REVIEW ON REQUIREMENT OF INTERMEDIATE HOLDING POSITION LIGHTS DURING CAT I CONDITIONS

(Presented by India)

SUMMARY

This paper presents the analysis on the requirement of intermediate holding position IHP) lights during various conditions. Intermediate holding position lights at airports are provided at an intermediate holding position intended for use in runway visual range conditions less than 350 m. The IHP lights are switched on along with the taxiway centre line lighting. However, at several airports where taxiway centre line lighting is provided even during CAT I conditions (in lieu of taxiway edge lights), IHP lights are not required to be provided as per the present standards. This study is to analyze the requirement and other technical considerations regarding the same.

1. INTRODUCTION

1.1 The intermediate holding position lights are located along the intermediate holding position, at a distance of 0.3 m prior to the IHP marking, which consist of three fixed unidirectional lights showing yellow in the direction of approach to the IHP and at right angle to the taxiway centre line. These lights are switched on when RVR is less than 350 m. During all other cases, especially in the night when the RVR is more than 350 m, the intermediate holding position is being identified by the intermediate holding position marking only. Airports with CAT I/II/III operations prefer using taxiway centre line lights during all the categories of operations thus reducing the requirement of taxiway edge lights in all the required conditions

1.2 However, the IHP lights are being switched on when RVR is less than 350 m only i.e., for CAT II and III conditions, IHP lights would be illuminated along with the taxiway centre line lighting system as shown in Figure-1

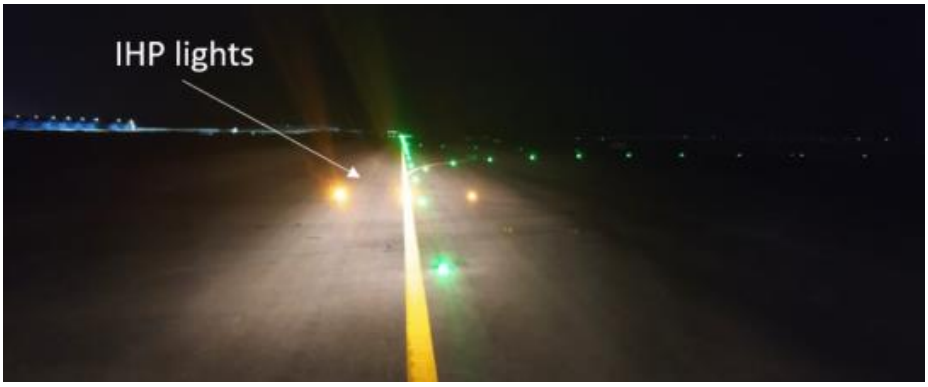

Figure 1. IHP lights along with taxiway centre line lights during CAT II/III conditions (In this case IHP marking is not done with retroreflective paint)

2. REFERENCES TO SARPS (ICAO ANNEX 14 VOLUME I)

Intermediate Holding Position Lights

5.2.11.1 An intermediate holding position marking should be displayed along an intermediate holding position.

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

5.3.21.2 ***Recommendation.—*** *Intermediate holding position lights should be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a Stop Bar.*

3. DISCUSSION

Issues with the Conspicuity of the IHP Pavement Marking

3.1 The runway and taxiway pavement markings would provide the required visual guidance during the day, when good visibility conditions, to the aircraft for safe manoeuvring. However, during night, the conspicuity of these markings is achieved by the usage of retroreflective materials. In general, these markings tend to deteriorate viz. faded colors, poor night time visibility, contaminant deposition, quality of retroreflective material etc., depending on several factors such as exposure to the harsh climatic conditions, wear and tear due to regular aircraft movement, cleaning activities such as sweeping etc. Identification of these markings is not reliable in all these cases as there are several factors which influence the desired functionality in addition to the above factors such as regular maintenance regime, climatic factors, visibility conditions, material properties etc. Especially in damp conditions, the markings don't function as intended in spite of the retroreflective glass beads and the contrast colour (black) provided at some airports as a background of the markings for better conspicuity as shown in Figure 2.

3.2 Based on the above considerations, IHP markings with retroreflective paint cannot be considered as a completely reliable visual aid especially in damp/wet night conditions, although marking could suffice the requirement in regular circumstances.

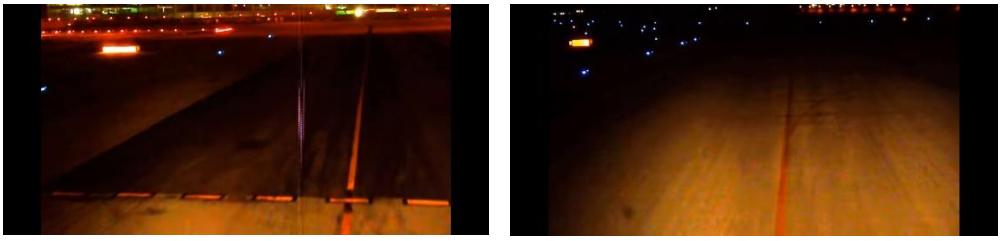

Figure 2. Typical IHP and taxiway centre line marking while taxiing of an aircraft during night

Human Factors and Technical Aspects Considered in Determining the Requirement of Intermediate Holding Position Lights

3.3 The response of taxiing aircraft/pilot would in general be easier when the system balance is being maintained in terms of analyzing the system parameter such as lighting, marking, guidance available with pilot, experiences with the airport topography and instructions from the ATC controllers. That is, the visual segment, which in this case also includes the marking, which shall be analyzed in conjunction with the lighting perspective. Especially when the pilot is taxiing using the guidance of the green taxiway centre line lights, a sudden change in processing of the visual segment of identifying the painted yellow marking could be a challenge.

3.4 The markings function as one of the visual aids, which provides guidance and defines the designated positions. IHP marking serves as a guidance to the taxiing aircraft, this denotes a designated intermediate taxiway holding position, which cannot be missed in any case as this marking is available only in certain positions. Hence, further increasing its necessity to be identified at the right time to stop the aircraft as per ATC instructions.

Case 1: Taxiing of the aircraft and establishing the IHP position during CAT I conditions with taxiway edge lights and guidance sign boards only as the guidance

3.5 From commencement of taxiing to parking and vice versa, the aircraft in this case would be guided with the taxiway centre line marking and taxiways are delineated with the taxiway edge lights. Guidance signage boards are provided at critical locations for guiding the aircraft to maneuver to the desired position. The aircraft from its exit from the runway and vice versa is continuously guided with the taxiway centre line marking including other markings over the taxiway, such as runway holding position (RHP) & IHP markings, taxiway edge marking, non-load bearing markings, and other ground markings etc. Some airports have retroreflective markings for better conspicuity with black paint markings as a background for further improving the conspicuity. It has been experienced that during rainy seasons and damp conditions, the marking perceivability deteriorates. However, in both the above conditions, whether without rain or with rain, the dark adaptation switchovers are very low as centre line lightings are not present. Also, as the pilot is already used to moving along the centre line marking with the available source of light from the aircraft (Figure 3) and align the visual field accordingly, hence, identifying the IHP marking is not a difficult task. This doesn't add anything major to visual workload, as it is deemed to be identified and the focus of the pilot primarily resides on identification of the markings, as there are no other visual aids.

3.6 However, during wet/damp conditions, where retroreflective markings are not effective, identifying the IHP position is definitely a challenge.

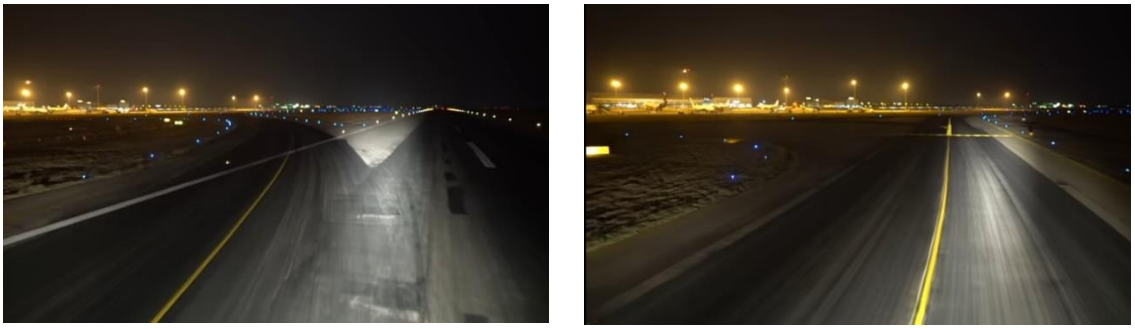

Figure 3. Aircraft identifying the Taxiway centre line marking from runway exit through its lighting

Case 2: Taxiing of the aircraft and establishing the IHP position during CAT I conditions with only taxiway centre line lights and guidance sign boards as the guidance

3.7 As per Annex 14, Volume I Standard 5.3.18.1 "Taxiway edge lights shall be provided at the edges of a runway turn pad, holding bay, de-icing/anti-icing facility, apron, etc. intended for use at night and on a **taxiway not provided with taxiway centre line lights** and intended for use at night, except that taxiway edge lights need not be provided where, considering the nature of the operations, adequate guidance can be achieved **by surface illumination or other means**."

3.8 Hence, based on the above Annex 14, Volume I, Standard 5.3.18.1, airports prefer to operate with taxiway centreline lights for guidance even during CAT I conditions for the airports which have to operate in all three categories of operations. In this case the reduced number of taxiway edge lights may be available. During taxiing time, the pilot relies on green centre line lights for the guidance which are much conspicuous in all the conditions, including rainy and low visibility periods. During this course, considering the dark background conditions in the night, the centre line lighting especially for long taxiways would be stretched as a single line in pilots' perspective, making it difficult to focus on the IHP marking as the switchover of bright to unlit source (marking) are in the same visual segment. Series of straight taxiway centre line lights would be seen as a clear guidance for the pilot in the dark background. This has an issue with the dark adaptation and the pilot would be following the centre line lighting guidance, which he has been used to and a sudden change in the identification of referring to the IHP marking when the background luminance produced by taxiway centreline lights creates a state, which he is not used to and is inconvenient during the course of taxiing by the aircraft. The visual acuity will be affected by the source of the light, which would be the obvious primary focus, the contrast (background) and the other target aspects in the visual field of the pilot. This process of identification of the intermediate holding position location adds to the visual workload of the pilot.

3.9 As described in Aerodrome Design manual (ADM), Part 4 – Visual aids 1.2.47 "Changes in experienced or accustomed visual cues can cause illusory perception problems."

3.10 Important "historical" factors or the intensities or luminances to which the viewer has been previously exposed, the duration of that exposure and the length of time elapsed between the previous and present stimulus complex" is one of the major factors in assessing the AGL system requirements.

3.11 We can infer that a pilot who is experienced in identifying the IHP position using the IHP lights, when taxiway centre line lights are "ON" or a pilot who will be flying from airport with CAT II/III configurations, where taxiway centre line lights are provided with intermediate holding position lights or the pilot where his duration to the exposure of the taxiway centre line lights, would find it difficult in processing the IHP marking with the available visual cue of only taxiway centre line lighting.

Technical Considerations and Implementation

3.12 The pilot also needs an information in order to assess the length of taxiway as shown in Figure 4 below for him to be cautious prior to approaching an intermediate holding position. The earlier the pilot is made cautious about an intersecting taxiway, the better it is for the safety while taxiing. This can only be achieved with the intermediate holding position lights in place and obviously, this would be applicable for the cases 1 and 2 as described above.

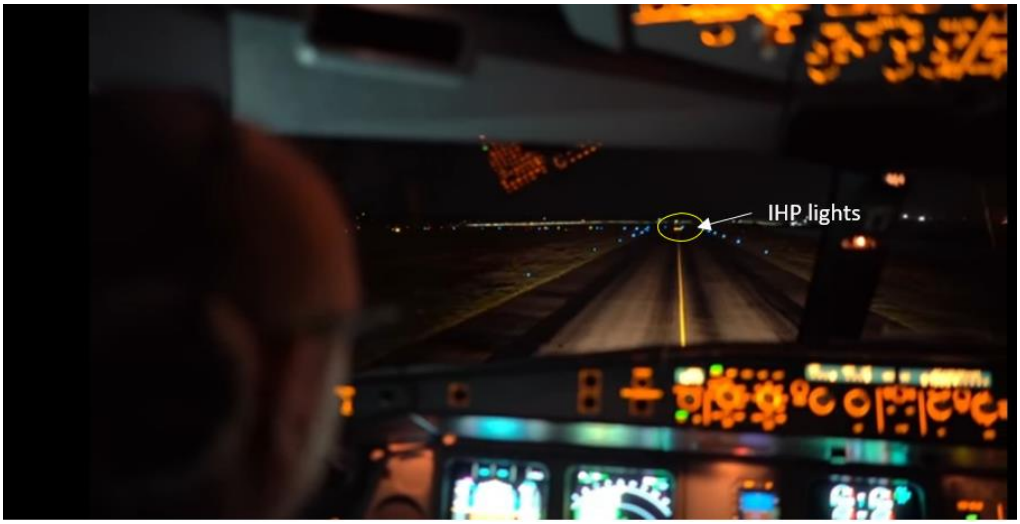

Figure 4. IHP lights form distance on a taxiway with taxiway edge lights

3.3.1. As per Annex 14, Volume I Standard 5.3.21.4 *"Intermediate holding position lights shall consist of three fixed unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution similar to taxiway centre line lights, if provided. The lights shall be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5 m apart*". Hence, this requires 3 unidirectional lights per location. Considering the safety aspect, which would be achieved, the installation cost even for small airports wouldn't be much. Also, the circuits can be easily connected with the existing circuits. However, if airports with only taxiway edge lights as their guidance wants to operate IHP lights, lower intensity lights are recommended, as Taxiway edge light circuit would be operated in just 3 intensities, 10%, 30% and 100%.

3.3.2. However, for the airports with taxiway centre line lighting as their guidance for manoeuvring, IHP lights can be connected with the taxiway centre line (TCL) lighting circuit and have same illumination level of the TCL lights, thereby ensuring the balance is achieved as per the requirements.

Inferences

3.2.1 Based on the above discussion, the following recommendations are made:

- Airports operating under the CAT I conditions and having taxiway centre line lighting as guidance for taxiing, the IHP lights should be provided
- It is recommended to have intermediate holding position lights for airports operating in CAT I conditions and having taxiway edge lighting as guidance for taxiing. However, the brilliancy should meet the intensity requirements for RVR conditions greater than 350 m.

4 ACTION BY THE MEETING

4.1 The meeting is invited to:

a) note the information contained in this paper; and

b) review, discuss and recommend the following revisions in "Annex 14, Volume I, 5.3.21 Intermediate holding position lights":

Application

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

5.3.21.2 **Recommendation.—** *Intermediate holding position lights should be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a Stop Bar.*

5.3.21.3 Where taxiway centre line lighting is provided as part of operational requirement, the intermediate holding position lights shall be provided **at intermediate holding position** irrespective of runway visual range conditions

5.3.21.4 ***Recommendation****.— When taxiway edge lighting is provided for taxiing guidance without taxiway centre line lighting system, intermediate holding position lights should be provided.*

~~5.3.21.5 If 5.3.21.4 is followed, the light distribution of intermediate holding position lights shall be similar to taxiway centre line lights which are intended for use in runway visual range conditions of 350 m or greater.~~

Location

~~5.3.21.3~~ ~~5.3.21.6~~ 5.3.21.5 Intermediate holding position lights shall be located along the intermediate holding position marking at a distance of 0.3 m prior to the marking.

Characteristics

~~5.3.21.4~~ ~~5.3.21.7~~ 5.3.21.6 Intermediate holding position lights shall consist of three fixed unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution similar to taxiway centre line lights if provided. The lights shall be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5 m apart.

—END—