ICAO SAFETY

Flight Operations in Low Visibility Conditions

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Meeting to enhance State Coordination between MET, AIM, and ATM fields

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Agenda

1. All weather operations
2. Importance of Meteorology
3. Cost-benefit analysis
4. Flight operations in low visibility conditions
5. Pilot's perspective
6. The human element in ground visual aid use
7. Runway visual range – RVR, slant visual range - SVR and visual segment
8. Examples
9. Summary

All Weather Operations

- The aim is to improve traffic regularity in limiting visibility conditions maintaining the accepted safety levels
- Pilot is part of the system
- It demands a high-level of reliability, integrity and accuracy
- ATS, AIS and MET participation in a coordinated way is key for the success of the mission

Importance of Meteorology

- Contributes to enhance safety and efficiency
- Pilots can create an accurate scenario in their minds of the expected departure, enroute and arrival meteorological conditions for the planned trip
- Pilots can select strategically the best course of action for the success of the mission
- Accepted level of safety is maintained
- Optimized operations contribute positively to minimize the impact of the activity in the environment

Cost-Benefit Analysis

- The provision of all weather landing facilities involved considerable expenditure
  - On ground and airborne facilities
- Benefits are the improved regularity and safety and make the activity sustainable
- Higher workload for instalations, certifications, authorizations, training and maintenance by aerodromes, operators and States

Flight Operations in Low Visibility

- Major pilot concern is that the instrument phase of the approach is lenghtened and the visual phase is shortened
  - Instrument phase: pilot seeks to known the aircrafts position is likely to be when visual contact is made
  - Visual phase: pilot must verify the aircraft position and decide whether to continue the approach and land or go around
- When aircraft is at the minimum Cat II DH of 30 meters the runway is less than 5 seconds away

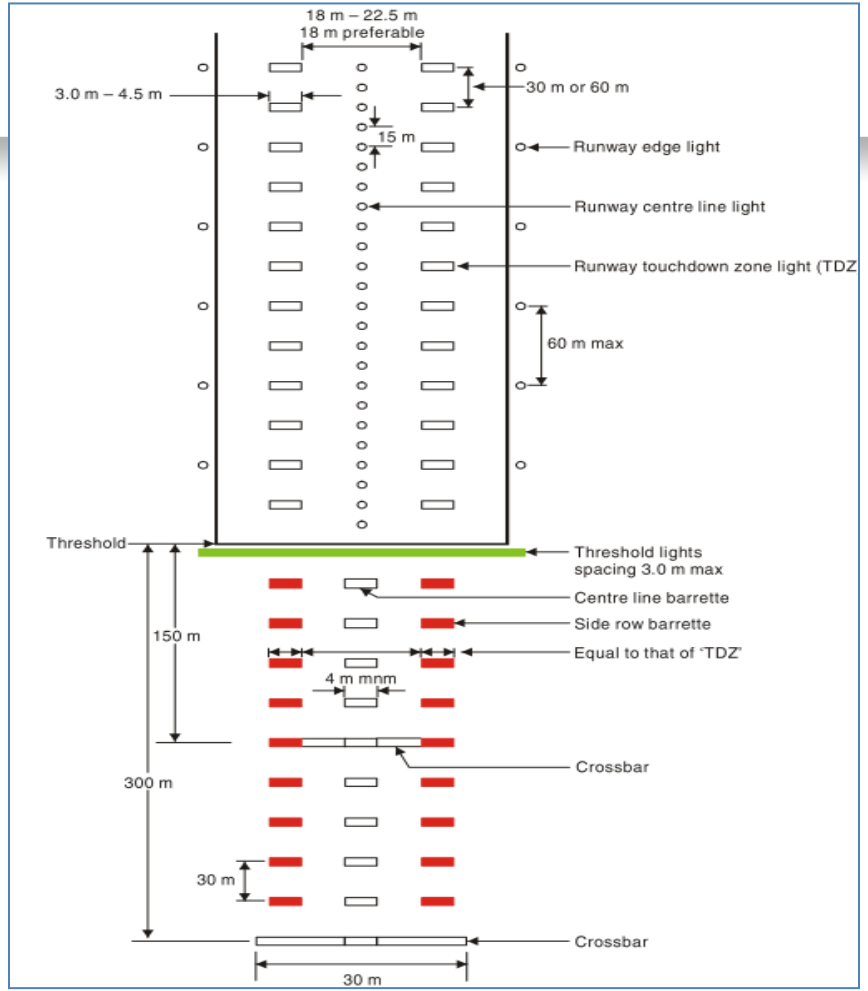
Pilot's Perspective

- Human beings are two-dimensional; as we take to the air we add a third dimension
- Continuous simultaneous corrections in all three dimensions are necessary in order to follow a correct flight path
- Aircraft may be controlled:
  - Manually or by means of automatic pilot
  - By reference to the instruments or to the visual cues in the outside world

Pilot's Perspective (Cont.)

- An approach and landing is the intersection of two planes at right angles
  1. Extended center line of the runway
  2. Approach slope
- Aircraft must cross the runway threshold with a safe margin of height and speed
- Speed and rate of descent must be reduced in the flare
- After touchdown, the pilot needs directional guidance to keep the aircraft in the runway and then to taxi to the parking position

Inner 300 m approach and runway lighting for precision approach runways Category II and III



Source: ICAO

Examples of approach and runway lighting

Examples of approach and runway lighting

The human element in ground visual aid use

- System standarization: is extremely important
  - Pilots see the approach and runway lighting in perspective
  - Pilots see them complete only in good meteorological conditions
  - They are moving continuosly
- Individual differences: must be considered
  - Age
  - Fatigue
  - Adaptation to light levels
  - Pilot proficiency, etc.

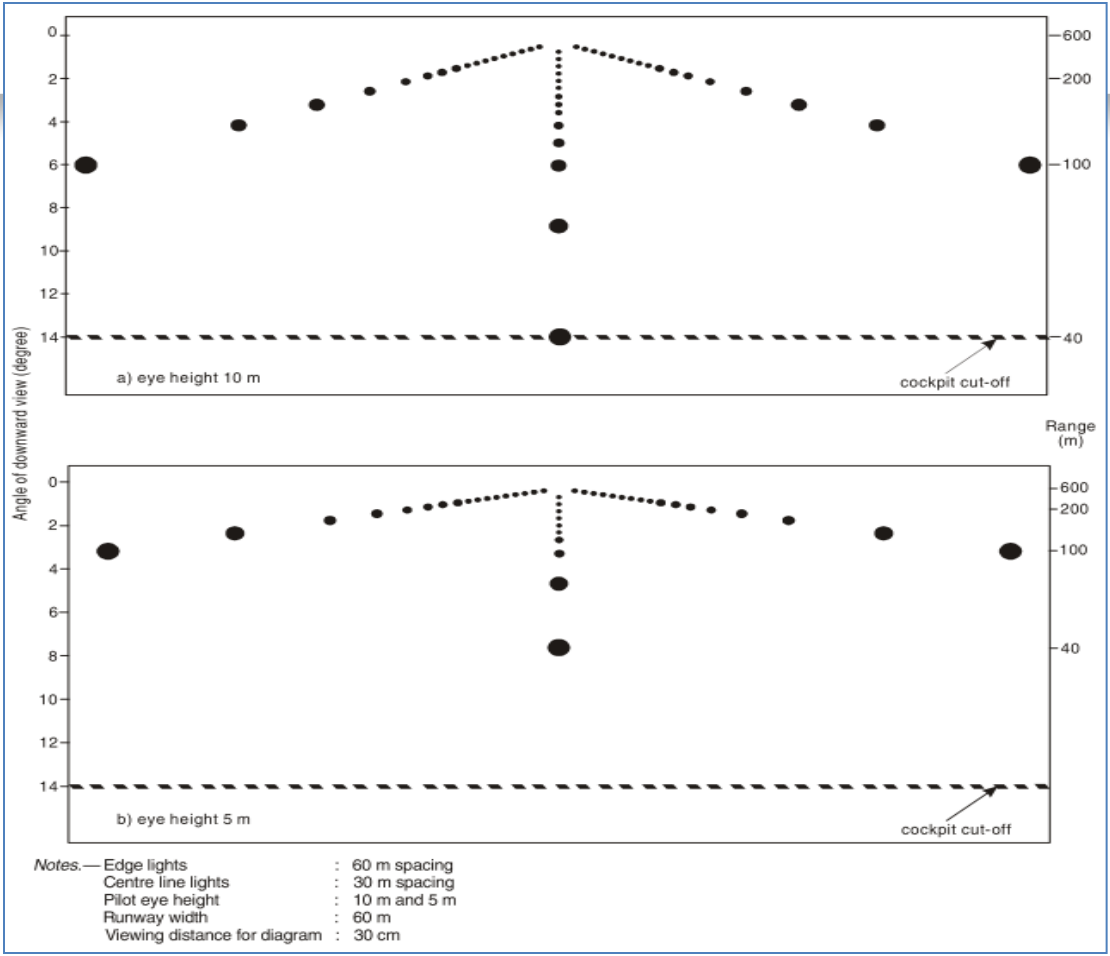
The human element in ground visual aid use

- Mechanics of seeing: must be understood
  - Approach and runway lighting patterns emphasize center line
  - Intensity setting must match ambient conditions
  - Intensity of the various section (colours) of the system must also match
  - Consider that:
    - Fovea of the eye is only 1.5 degrees in width
    - Average time for a pilot to switch from outside visual cues to instruments and back is about 2.5 seconds
    - High performance aircraft will travel 150 meters in this period

The human element in ground visual aid use

- Visual workload: is important
  - Pilots data processing capability and reaction is extensive if situation unfolds as expected
  - This capacity may break down where input data are ambiguous or transitory
  - Visual workload is best moderated by standardization, balance and integrity of elements to avoid momentary dissorientation, visual illusions or induce error
  - Other elements are: pilots eye position, cockpit cut-off angle, meteorological conditions, day or night, instruments, avionics, etc.

Edge and center lights as seen by the pilot during landing and take-off



Source: ICAO

Runway Visual Range - RVR

- Permits pilots to appraise aerodrome visibility conditions and to determine whether this conditions are above or below aerodrome minima
- Indicates visual guidance along the runway and some indication of seeing conditions on final approach

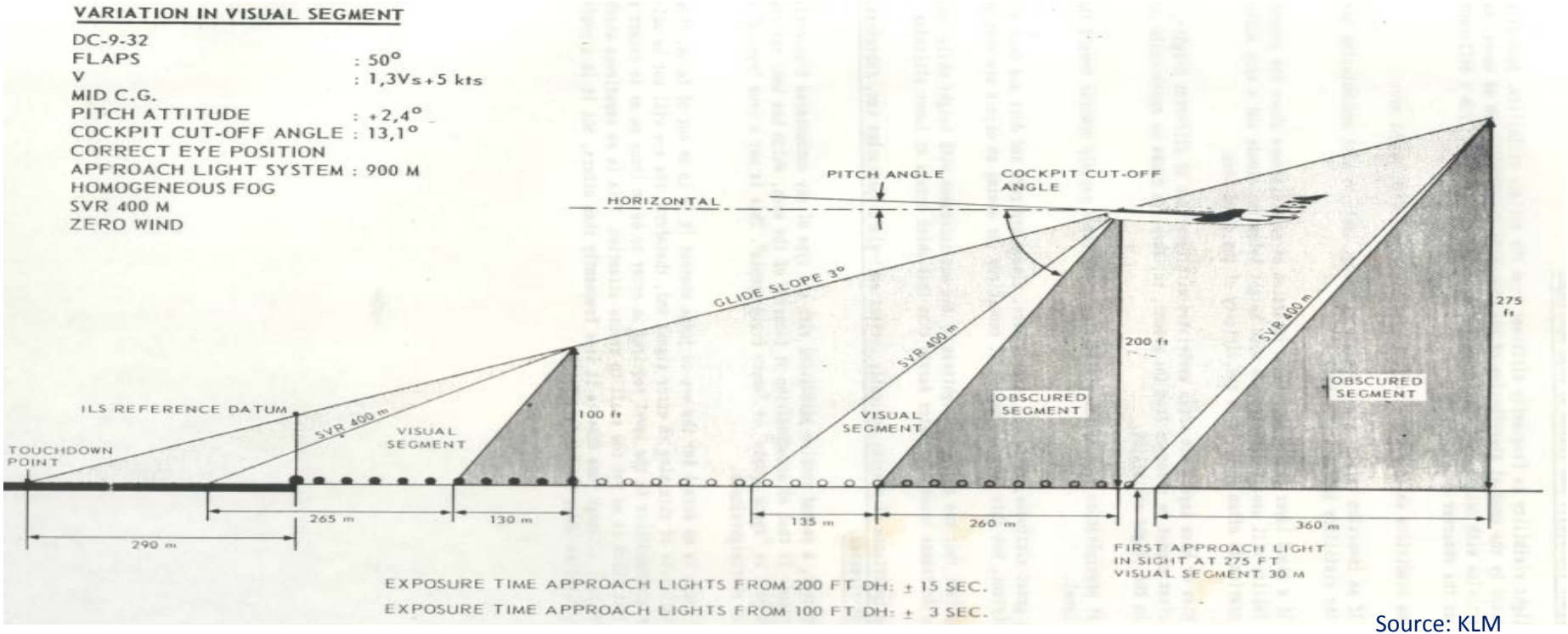
Additional Concepts

- Slant Visual Range (SVR): determines the distance between the pilots eye and the fartest light he can see
  - The distance to the nearest light depends on the altitude and the cockpit cut-off angle
- Visual segment: is the lenght of the approach light pattern in view at any one instant of time
- Cockpit cut-off angle: between the longitudinal axis of the aircraft fuselage and an incline plane below up to the limit at which the pilot can view.
  - Around 11° to 15° for different aircraft

Variations in Visual Segment

- The pilot needs for assimilate and interpret the visual cues:
  - A sufficient exposure time to the lights
  - A minimum visual segment during the final approach
- Transition from instruments to visual reference
  - From 200 ft to the point where the runway threshold lights disappear from view is 10-12 seconds
  - At 100 ft exposure time is 3-5 seconds
  - Rough guide for the minimum acceptable is a 150 meters segment (5 lights) ahead of the aircraft

Variations in Visual Segment



Source: KLM

Examples of approach and runway lighting

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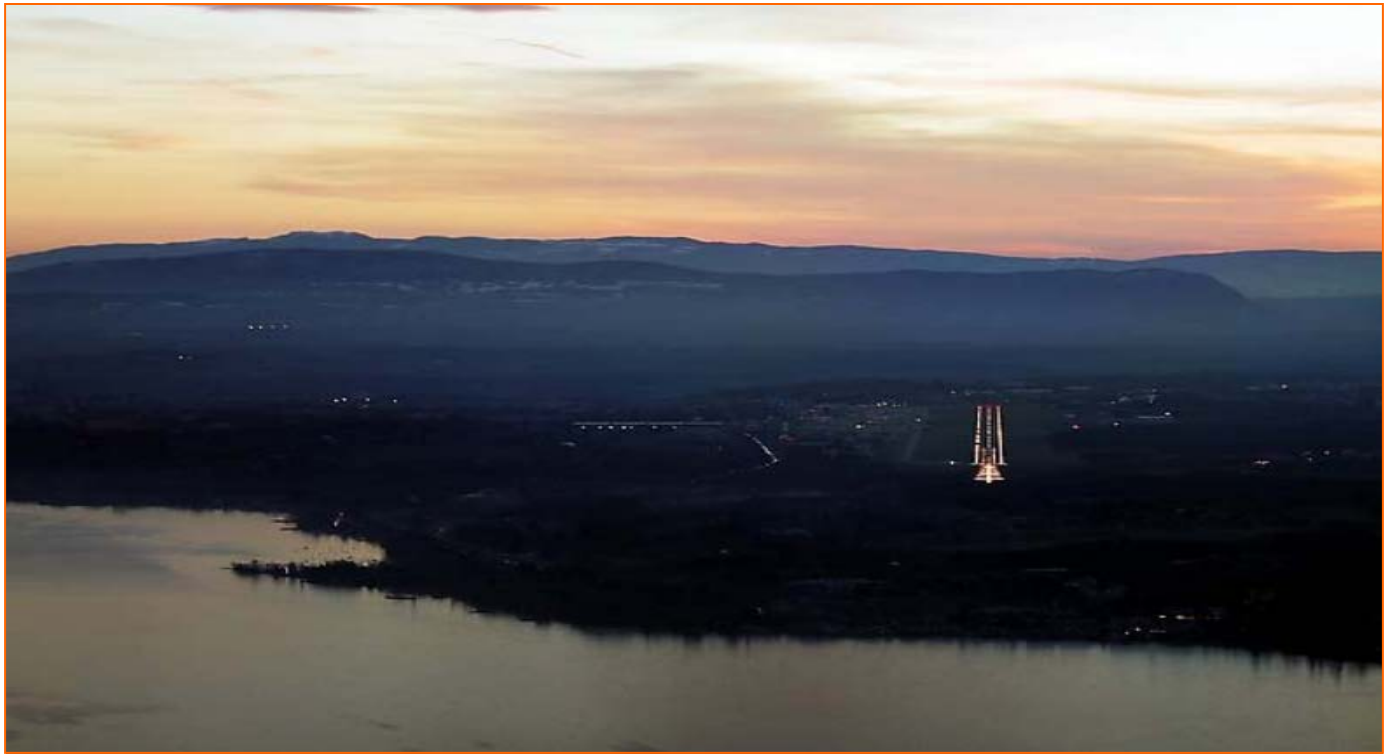

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Summary

- Successful low visibility operations require a team effort that begins in the weather forecast phase
- Low visibity operations are highly demanding
- Proper coordination among ATS, AIM and MET are key for the success of the mission
- Safety levels must be maintained
- ICAO is committed to lead the international aviation community in promoting the highest standards of safety

THANK YOU!

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