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Indian Airlines
Capt. P.N. SHARMA
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INDIA

Dear Captain,

You will find enclosed a copy of your brochure "CAT 2 WISDOW" you sent to us for comments.

We would like to mention that we found it very informative, and believe it is a comprehensive guide regarding the operational aspects of CAT II/CAT III.

On the attached copy you will find directly some comments for your consideration.

Do not hesitate to contact us if you need further information.

Truly Yours,

Guy DI SANTO
Dept Manager
Airlines Operations Support

Michel BRANDT
Deputy Director
Flight Operations Support

DEDICATED TO THE

SPIRIT OF

PROFESSIONALISM

PREFACE

For the past several decades our aviation professional achievements and human consciousness were developed to a level where the conduct of ILS CAT I were being accomplished with a consistent standard of safe performance.
The modern airline pilot has arrived at a stage where it has now become imperative to transcend to a higher plane of human consciousness / awareness i.e. to inculcate within, a strong determination to arise & awaken to a higher platform of professionalism.

Proper understanding of low visibility *and* All-Weather-Operations (AWO) is necessary to implement a perfect blend of *knowledge & skill* in order to present the traveling public the highest level of *EFFICIENCY* in regard to airline's flight scheduled performance. Efficiency contains within, the aspects of flight safety, passenger comfort, on-time performance and economy. Now, this new objective has become a very important and demanding concern in today's modern life-style and also affects the image & reputation of the airline especially amongst competitive environment.

Disciplined approach in life, righteousness, to be aware of our true being, the proper use of our body-mind-intelligence faculties and other such virtuous endeavour is very important to permeate through our limited boundaries of human-intelligence. Only then could the human evolutionary process be accelerated to enable one to transcend and enjoy higher planes of human consciousness and understand the True Nature within.

The intention of this brochure is an attempt to explain the various operational aspects regarding Low-Visibility operations, in a manner to provide an easier transition to CAT II operations in regard to A-320 aircraft. The law abiding requirements for CAT II / III operations and other informative aspects could be obtained from ICAO documents, state regulations and various other company publications.

SECTION I

METEOROLOGICAL FACTORS

VISIBLITY / VISUAL RANGE CONCEPTS FOR CAT II / III

The RVR met reporting / requirement, its concept and need is already familiar to all aviators and in practice world over. A new concept of SVR has been established in regard to CAT II / III operations.

RVR CONCEPT (ICAO)

This is an electronic instrument derived method of obtaining visibility in a particular direction. This technique is more useful during low-visibility conditions as the human observer cannot assess with requisite accuracy consistently in comparison to advanced computation technology of the RVR transmissometer & its associated link-ups.

The RVR computation is based on :
(i) The atmospheric Transparency in the 'Horizontal plane' at close ground proximity.
(ii) The background luminance.
(iii) The intensity of runway lighting.

SVR CONCEPT

The ***'Slant Visual Range'*** (SVR) is the range / extent of visibility which actually would be available to a pilot during the approach and is of more significance than the normal RVR presentation. SVR is the range / extent over to which the pilot of an aircraft in the final stages of approach or landing can see ahead & below to identify the approach area, runway and its associated lighting or markings in respect to the portion of the visual segment, as explained in aircraft optics later in this section.

The SVR available to a pilot is affected by **:**

1. Atmospheric transparency between eye to ground lighting /markings.
2. Air Density, which has direct relation to the characteristics of the fog prevailing.
3. Transparency of the Windscreen due to the quality of material used.
4 Quantum of the water / moisture on the windscreen.
5 Cockpit & ambient Lighting.
6. Sudden Light exposure to pilot eye of any illumination, prior to or during the process of viewing at the desired target area.
7. The type of fog prevailing, whether shallow or matured fog.

F O G

There are two types of FOG patterns that normally prevail during winter. One is the Shallow fog and other the Deep Stable / Matured Fog. With the current available detection technology, it is very difficult for one to precisely predict the type of Fog that could prevail at a particular time, and with what characteristics and extent. In the pilot's point of view, the Slant Visual Range (SVR) is of concern during any approach-to-land.

I SHALLOW FOG

This is a fog layer which is confined to close proximity of ground thereby forming a ground fog layer which affects to about 15 ft. above the ground surface *only*. Usually this fog formation occurs due to release of ground moisture during the pre- sunrise period and after dusk.

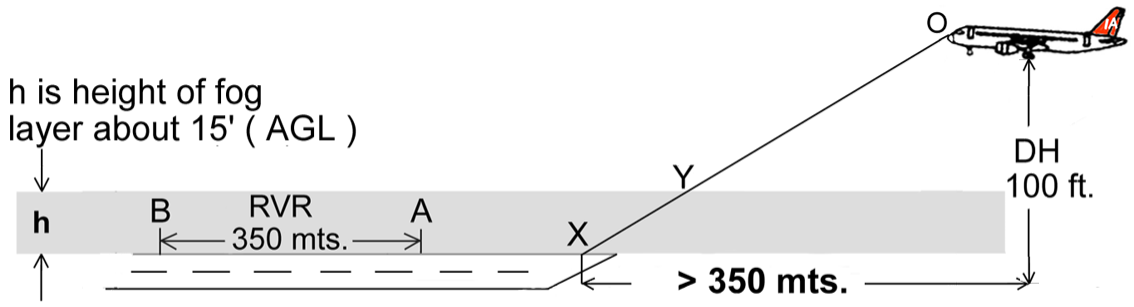


FIG. 1 SHALLOW FOG

From the above fig.1, it can be seen that the observer / RVR equipment at A can see towards B a distance of about 350 mts. The distance A to B remains contained within the shallow fog affected area 'h' i.e. height of layer of fog above ground.
In case of an a/c at 100 ft., at the DH, the vision OX is >350mts. because the segment OX is only affected by the fog layer by 'h' , i.e the segment from Y to X.
Vision OY is better as it remains unaffected by the fog layer hence the result is that the pilot SVR is even better than the RVR vision.

As the a/c descends below Y, the visibility for the pilot suddenly reduces to the reported value and the pilot perspective changes. Hence a pilot should be aware of this aspect whenever shallow fog or a lower visibility is reported although it may appear fine when the aircraft is overhead or approaching on finals.

II DEEP STABLE / MATURED FOG

This is a type of fog formed due to an abundance of moisture available. The density of this fog increases with the presence of air contaminated with dust & smoke/ pollution. In this type of fog as seen in fig.2, the density of the fog INCREASES with height above ground, the vertical height 'h' of the fog layer is more than that of the shallow fog. This results in an SVR value lower than the prevailing RVR as seen in fig 2 below.
Here, the pilot at O can see for a lesser range in comparison to the RVR on ground because the vision of the pilot is also affected by a more denser layer of fog from Y to X than the rarer fog layer on ground, for the RVR transmissometer to see from A to B.

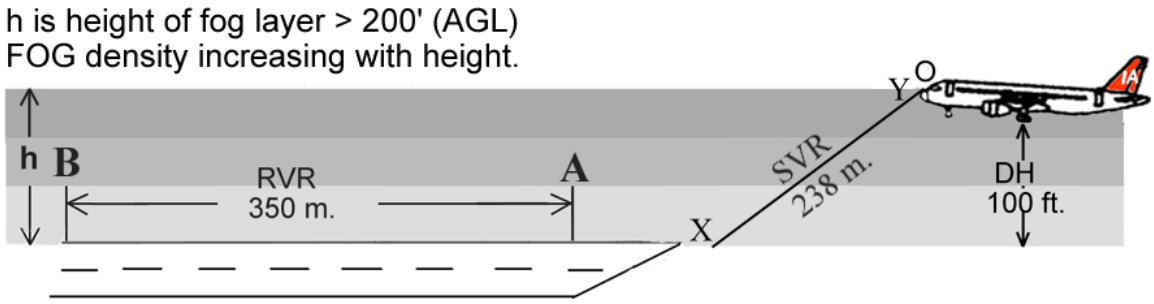


FIG. 2 RVR & SVR RELATIONSHIP IN DEEP STABLE / MATURED FOG

Based on experiments, practice & experience from met. data gathered over the last four decades an approximate relationship between SVR / RVR has been established which would, in 90 % probability effect an SVR value that could be ' *equivalent or more* ' to its corresponding RVR value as factored below **:**

Height of Pilot-eye	SVR Value
171 ft. (150' DH)	58 % of reported RVR
121 ft. (100' DH)	68 % " " "
71 ft. (50' DH)	77 % " " "

The reported RVR value when reduced by the above factor is the approximate SVR value available to the pilot in 90 % chance.

example **:** DH 100 ft. ; RVR 350 mts.
SVR = 350 x .68 = 238 mts.

Hence, when a RVR 350 m. is reported the SVR value available to pilot would normally be either 238m *or more* at 100 ft. DH. i.e. 90% probability / chances could be a value equal to or even more than 238 mts.

LOW VISIBILITY DIS-ORIENTATION FACTORS

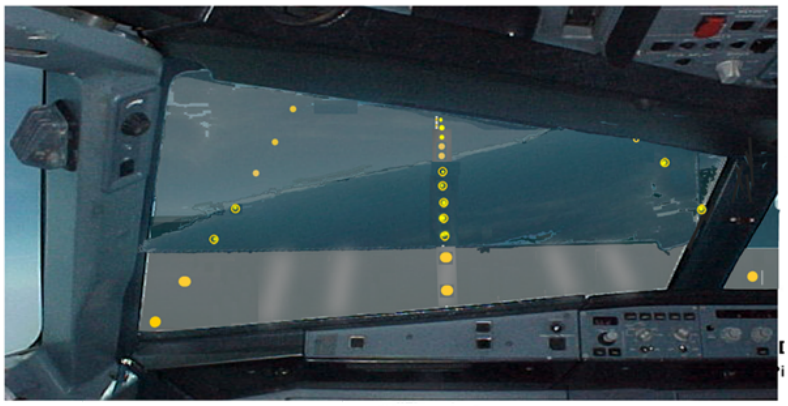
I EFFECT OF LIGHT ON FOG PATCHES :

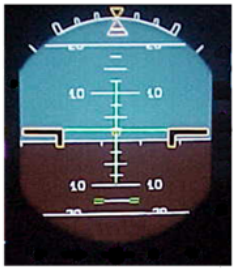
The fog characteristic may not always be a uniform pattern covering the entire area. Fog patches can be noticed drifting over and across the runway and its adjacent areas.

The illustration shows how light rays, indicated by white arrowed lines, could travel & reflect on fog patches to cause one patch to glow-up.

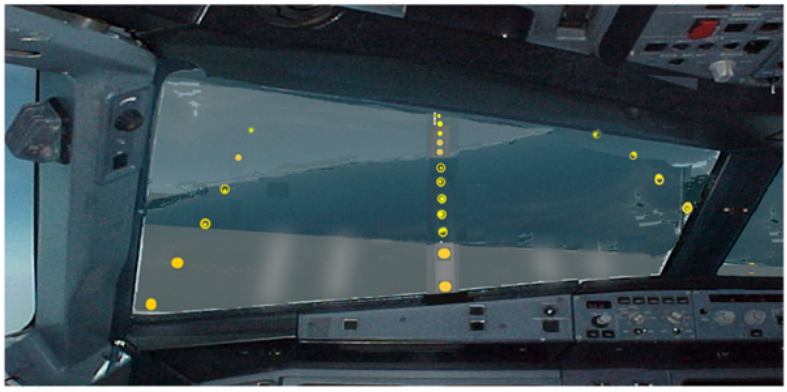
Example 1 **:**

The effect of light reflection and refraction on these patches caused due to runway / ambient lighting can be such that the light could glow up on a portion of a fog patch which is not symmetrical in shape and could present an illusory perception to the pilot who is looking out. The effect of this is that the pilot may apparently lose his attitude orientation regarding the natural horizon during the flare phase of a manual landing. The manner the light scatter could reflect upon the pilot eye could be irregular and the pilot may initiate a bank or perhaps not recognize an induced bank or could overcorrect the visual perception of an uncalled requirement whereas the a/c may already be straight & level. This deceptive illusion could be avoided if the pilot before making any such corrective bank/lateral inputs while close to ground, makes a quick glance at the top of the PFD bank index to ensure if at all there is need for any such input. It would certainly involve an attention reversion into the cockpit but this could be very purposeful instead of becoming a victim to an optical illusion and its subsequent serious consequences.

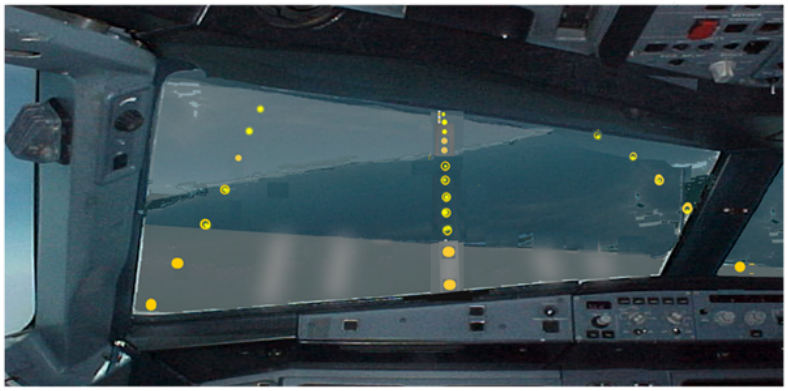




AT FLARE, WINGS LEVEL : Notice the fog layer with a horizontal base / surface parrallel to the horizon



AT FLARE, LEFT BANK (about 5°) : Notice the effect of the bank, the external perception indicates an inclined fog base / surface tilted with the aircraft bank.



AT FLARE, WINGS LEVEL : In this case, the wings are at level, but the fog layer has a tilted base / surface of about 5°.Outside visual perception is similar to the above illustration i.e. of a left 5° bank.

Example 2 **:**

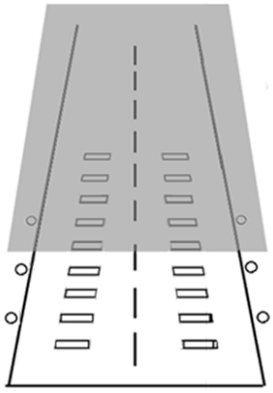
The shape, size and angular installation of an aircraft's windscreen along with its glare-shield overhang could at times present the human pilot-senses with deceptive illusions when the pilot is groping to rely on natural human-brain horizon during the flare phase while looking out, with fog patches floating on and across the runway.

The illustration shows the manner how irregular patches can create a perceptive hazard. An illusion of a false natural horizon can be seen where the a/c may not be in a bank but the presence of an inclined fog patch surface's reflected light may project an impression of a false inclined horizon to feel as if the aircraft is in a bank, or vice-versa.

II. PERCEPTION OF BEING HIGH AT FIRST VISUAL CONTACT

" DUCK-UNDER"

When operating under low-vis. conditions, as the pilot makes first visual contact with the approach lights / runway, 'only a limited portion' of the approach lights or the runway can be seen as shown.



This leads to an illusory perception / judgment of runway shortness and being high on profile resulting natural instinctive reaction for the pilot to subconsciously induce a pitch down input and causing uncalled problems.

To avoid being disillusioned by this, the pilot must anticipate, mentally prepare & review this aspect each time before commencing a low-vis. approach.

EFFECT OF RAINDROPLETS / MOISTURE ON WINDSCREEN

CLEAR NORMAL VIEW

EFFECT OF FOG ON VISION

III. MINOR FACTORS CONDUCIVE TO PILOT DISORIENTATION

Several accidents due pilot error have occurred when the a/c has deviated below the normal approach path after becoming visual at Minimums, this is due to illusory disorientation of human mind/ senses as several factors affect proper assessment **:**

(i) WIND SHEAR **:** A wind shear on short finals would result a significant change in body angle / pitch attitude of the a/c thereby momentarily *reducing or increasing* the visual segment distance. Bear in mind the wisdom of complacency in regard to a hypothetical situation where because the preceding aircraft has landed safely so you could also find the same prevailing conditions suitable to land. The wind-shear magnitude could grow worse in a matter of seconds. Do not hesitate in going around by rigidly maintaining to your pre-conceived imaginations & presumptions.

(ii) STRONG HEAD-WIND COMPONENT **:** Normally the pitch attitude of A320 during an ILS approach is about 2.5^{O} with flaps Full.
For a Vapp of about of 140 kts., with a HWC 30 kts.+ GUST the Vapp increases from 140 to about 160-170 kts.(approx) This would result the a/c to pitch down towards 0^{O} and even lower depending upon the wind and a/c weight. This aspect of a decrease in pitch attitude is an advantage as it increases the available visual segment. Similarly a TWC or a marginal CG loading could affect an unusual increase in pitch attitude thereby *reducing* the visual segment availability.

(iii) REFRACTION **:** Due to moisture / water on windscreen the transparency of the w/screen is reduced and may effect a perception problem to cause objects to appear lower than their actual heights or present an apparent horizon below the true horizon, as shown in the illustration on page 9.
Hence it is very important to simultaneously monitor the auto-callouts / radio altitude to have a proper assessment of the situation.

(iv) EFFECT OF ROLL **:** If the wings are not level the left seat pilot will have a minor effect of a reduced visibility during a right bank.

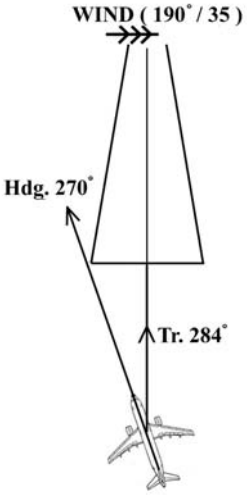
(v) R/W SLOPE & LIGHTING **:** The brightness of the approach & runway lights could also lead to illusive perception. A poor / dim lighting gives the impression of being high. Always cross-check and stick to crew task sharing.

Illusionary disorientation, its judgment and associated effects on human intelligence cannot be easily counteracted by a human using natural instinctive / sensory organs. He must overcome this by immediate reference to the a/c instruments to assess and correct any chance for an inadvertent departure from normal flight progress. Effective crew coordination, constant instrument cross-checks, optimum use of flight instruments and visual cues is a positive remedy to erroneous visual perception and related disorientation. *For these reasons, the Airbus Industrie recommends to use Auto-Land during CAT II visibility conditions to prevent any such illusionary disorientation.*

IV. ILLUSION DUE TO CROSS-WIND CRAB

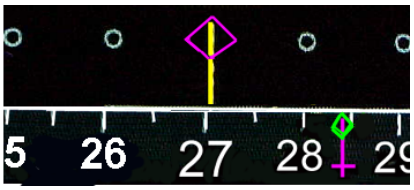
During a X-wind approach, the a/c would be crabbing in towards the runway with an offset heading depending upon the wind. Under this situation during the approach, the pilot at first visual contact with runway / approach lights could err in interpreting his normal visual cues and perception resulting in an impression of not being aligned with the r/w center-line. Anticipate the deceptive illusion caused due to the Cross-wind Crab.

Moreover, i.e. if the wind is from the left side, the a/c would crab towards left, say about 270^{O} for VIDP R/W 28 (runway orientation 284^{O}), this about 15^{O} offset would result in the forward vision of the pilot on left seat to get partially reduced by the nose structure of the aircraft and the vertical post of the windscreen.



Anticipate this aspect and monitor the offset angle on the ND i.e. the difference between the track green diamond and aircraft heading.

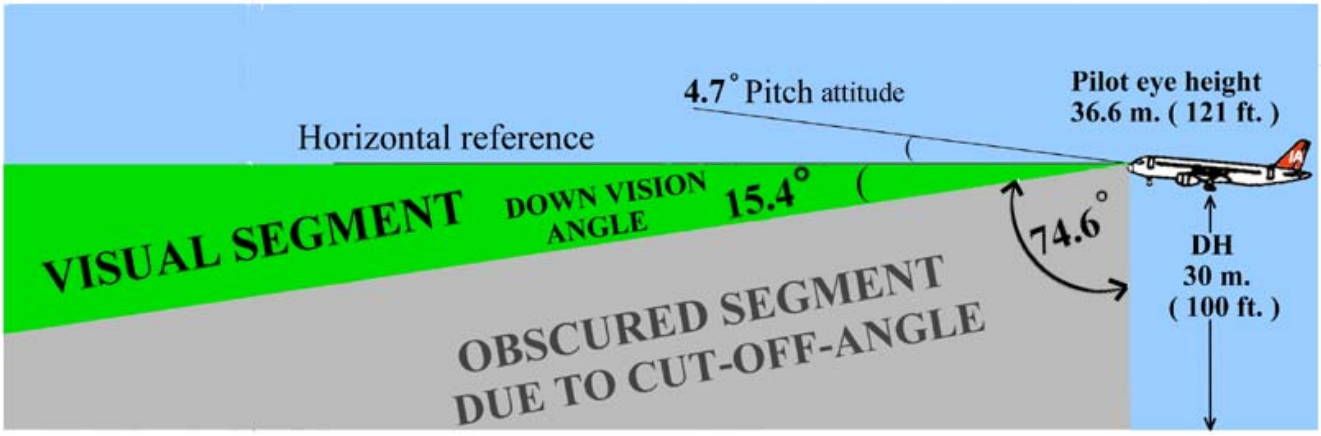
During the approach the cross-wind component could be about 30 kts. or more which could amount a large crab-angle. When looking for visual reference at DH, do not look along the fore & aft (longitudinal) axis of the aircraft but look at the offset axis, track making good. i.e. in the green diamond direction.



LOOK TOWARDS THE GREEN DIAMOND DIRECTION
WHEN ATTEMPTING TO SIGHT THE RUNWAY
DURING STRONG CROSS-WIND CONDITION.

AIRCRAFT OPTICS (A-320)

Aircraft Optics, its availability and understanding is a very important factor in the conduct of CAT II / III flight operations. Based upon the aircraft characteristics & design, the vision available to the pilot and its most optimum use would significantly influence on ***pilot judgment & decision*** at the most crucial phase during a low visibility approach and during the take-off & landing roll.



PILOT VISION

(i) **DOWN-VISION ANGLE :**
This represents the range / extent of "***precious & useful***" vision *ahead & below*, available to a pilot. This angle extends from the pilot-eye straight ahead parallel along the horizon downward, limited by the axis tangential to the glare shield / nose structure of the aircraft, with the pilot eye at the optimum position. This angle contains the visual segment angle, in case of limited visibility / RVR.

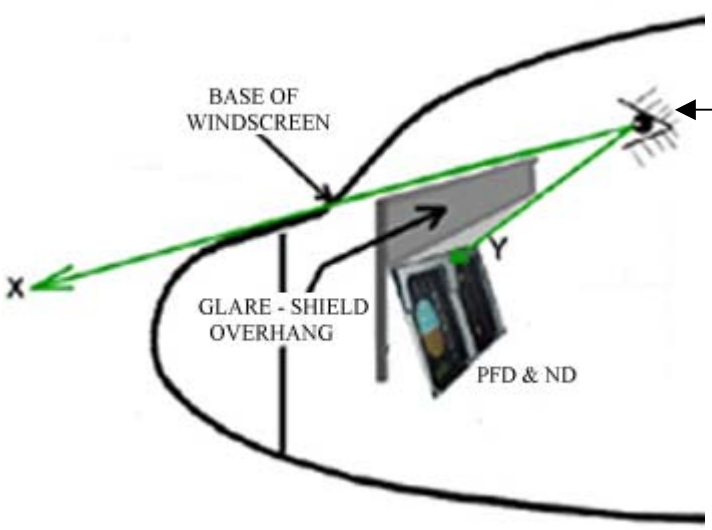
(ii) **CUT-OFF ANGLE :**
The term Cut-Off angle pertains to the range / extent of vision which is "***obscured / limited***" due to the presence of the glare shield and the nose of the aircraft. This is the angle which subtends from vertically below the pilot- eye upwards towards the horizon

tangential to the glare shield / nose- structure of the aircraft. This represents the OBSCURED SEGMENT.

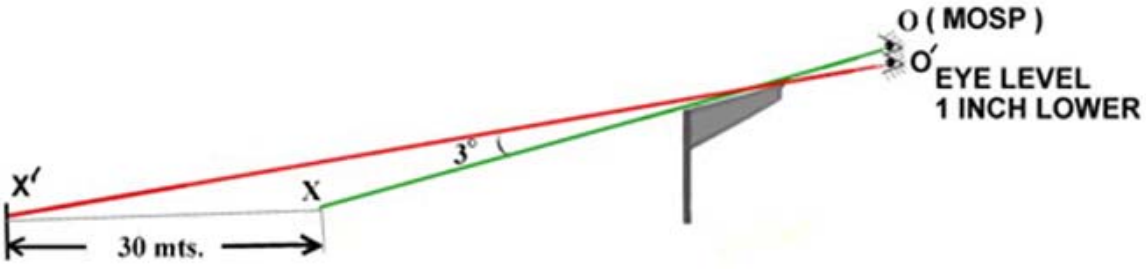
(iii) RELATION BETWEEN PITCH ATTITUDE, DOWN-VISION ANGLE AND THE CUT-OFF-ANGLE **:** Down Vision angle + Cut-off-angle = 90^{O}. Hence, if the pitch attitude of the aircraft is increased, the down-vision angle decreases and the cut-off angle increases and vice-versa. An increase in pitch causes reduction of the valuable down-vision angle and thereby reducing the visual segment.

(iv) EFFECT OF FLAPS ON PITCH ATTITUDE **:** The Down-Vision angle is best with flaps at Config. FULL during the approach and reduces by about 2^{O} with flaps at config.3, hence it is very important to use flaps full for CAT II / III approaches.

(v) EFFECT OF INCREASE IN Vapp **:** The Down-Vision angle and its associated visual segment increases with an increase in speed during the approach. For every 5 Kts. of speed increment in Vapp the pitch attitude of the aircraft is decreased by approx. 1^{o} which thereby reduces the cut-off-angle by about 1^{o} this results in an increased visual segment and is of an advantage to pilot during a CAT II approach.



CORRECT VISION AT MOSP :
The pilot-eye line of vision / sight, as shown by the green arrows, is best when at MOSP from where the pilot is able to see the top frame of the PFD / ND inside and can simultaneously see outside where the line of vision is tangential to the glare shield and the nose-dome, as shown.



MOST OPTIMUM SEATING POSITION (MOSP)

After having understood the importance of Down-Vision & Cut-Off angles, it is very essential that the pilot adopts the " ***Most Optimum Seating Position*** " (MOSP). The aircraft manufacturers have installed a triangular three-ball arrangement / configuration on the slanting / vertical mid-post of the two wind-screens for the pilot to adopt an optimum seating position suitable for normal operations.
For a CAT II / III operation, this method is not most suitable, a position which is about one inch forward and upward from the prescribed method using the triangular balls, works out to be the MOSP and has the following advantages **:**

(i) Is easy to achieve at any time during a dark cockpit.
(ii) Is much more effective as shown in the illustration.
(iii) Is absolutely fool-proof.

The seating is adjusted to the most forward & highest position, in a manner, which would enable the pilot to look outward to be able to see tangentially above the glare shield & nose-dome/ base of the wind-screen (as shown by line X) ***and*** simultaneously also be able to see the top frame of the PFD / ND i.e. the vision in direction Y, which would be limited by the glare shield over-hang structure / installation.
The effect of these X & Y lines of vision would result in the MOSP for CAT II / III operations both during the take-off & landing roll and would be *very much effective* during the important approach phase at DH and thereafter.
According to the Airbus Industrie, it is recommended to stick to the method of using the 3-triangular balls to determine the correct seat position.

DOWN-VISION ANGLE v/s EYE-POSITION

The effect of a seat position of " **ONE Inch lower** " than at MOSP can be seen by the illustration where the Down-Vision angle is reduced by about 3^{O} which results in reduction of the VITAL VISUAL SEGMENT by about 30 mts. This would amount to the reduction of the Visual Reference Available by about one light segment **less**.

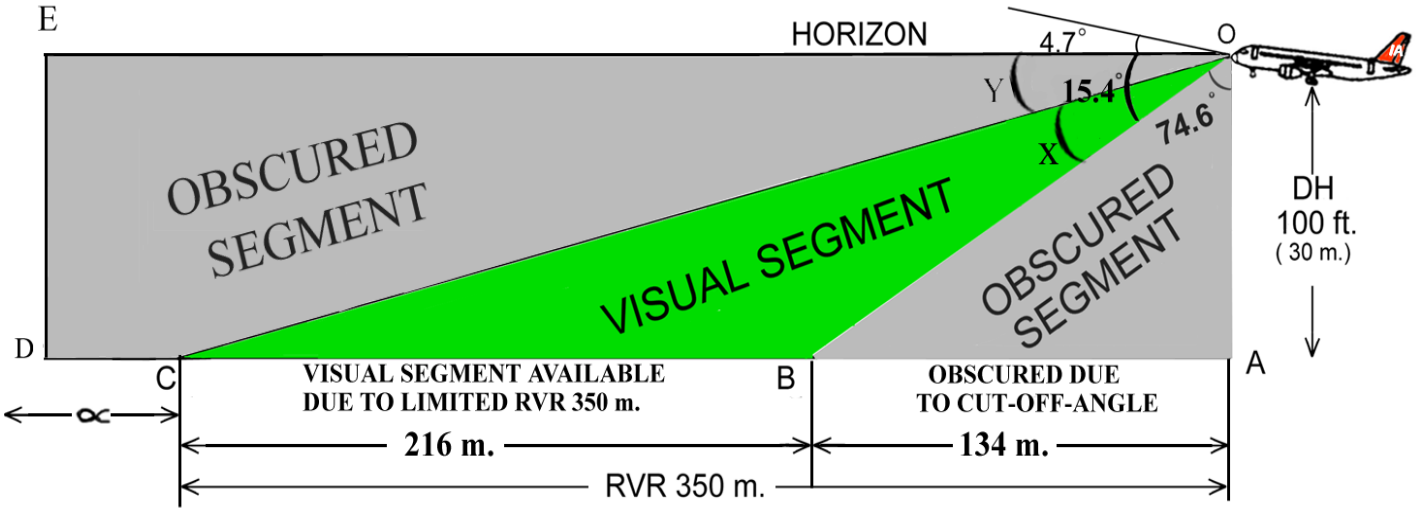
In case of a seating of about 2 inches lower, the effect would be very significant as this aspect would critically degrade the '**visible reference available** ' at DH, thereby affecting proper judgment and decision at the most crucial point.

As seen from the illustration, OX is the line of sight for optimum vision (green line). The red line O'X' is the effect of a seat position one inch lower which causes the visual segment to reduce by XX'. (loss of the distance of about 30 mts.)

I. VISUAL SEGMENT & OBSCURED SEGMENTS

VISUAL SEGMENT :

For CAT II /IIIA operations it is very important to understand the Visual Segment. This is the amount / extent of useful vision subtended by the 'Visual Segment Angle' in the approach direction ahead & below the aircraft available to a pilot at DH to see under a limited RVR condition so as to make proper judgment & decision. In this case, the visual segment forms as a part of the down-vision angle due to min. RVR of 350 mts. i.e. for an RVR of 350 mts. the ground segment B to C would be the range of vision available to a pilot at DH.



The green visual segment is the useful area of vision, pilot can see ground segment / distance B to C.

Note **:** (illustration's angles and distances are not to scale, shown with purpose to describe the various segments only. For trignometrical / geometrical calculations, refer appendix V, page 74 of CAT2 brochure)

[$X = 15.4^{o} - Y$, where $X+Y =$ Down Vision Angle (15.4^{o}) and
$Y =$ the angle which subtends an obscured segment due to limited RVR of 350m.]

TWO OBSCURED SEGMENTS :

(i) The first obscured segment is the one which has resulted due to the Cut-Off angle. Here the ground segment A to B would remain obscured to the pilot at DH. The Cut-off angle of 74.6^{0} would result an OBSCURED SEGMENT containing the distance AB. The

amount of Visual Segment & Obscured Segment availability would depend upon the DH and the prevailing RVR/SVR.

(ii) The second, resulted due to limited visibility (RVR). Here the segment C to D where the distance is up to infinity, would remain obscured due to limited RVR, i.e. in this case limited beyond 350 mts. from position A.

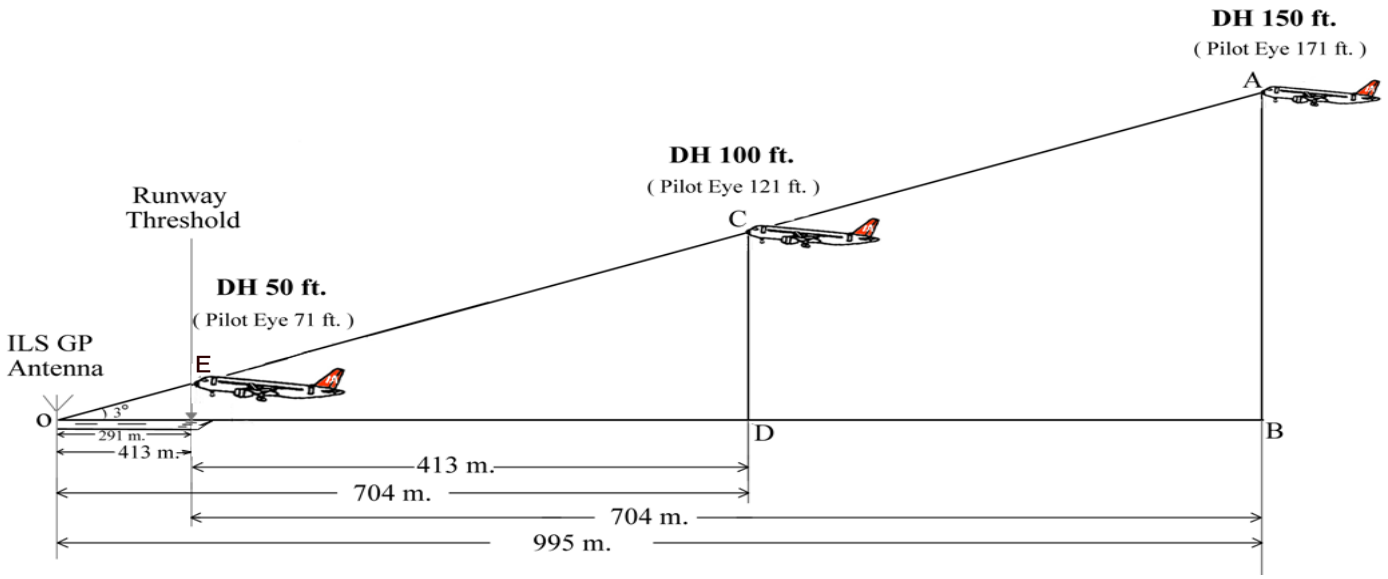
Hence, the total Down-Vision angle of 15.4^{O} would contain the visual segment angle as a portion during limited visibility conditions (Green Shaded area).
In case of unlimited visibility, the Down-Vision Angle = Visual Segment Angle.

II. HORIZONTAL DISTANCE OF THE AIRCRAFT FROM RUNWAY THRESHOLD AT VARIOUS DHs (150/100/50 ft.)

[Pilot Eye = Wheel Height + 21 ft. during an ILS approach)]

[For a TCH of 50 ft.(VIDP28) : G/S antenna height = 50 ft., Aircraft Wheel Height* = 34 ft., pilot eye height = 55 ft.]

***(aircraft wheel height is measured from the lowest portion of the main wheels vertically downward)**



SECTION II

A-320 CAT II / III OPERATION

OBJECTIVE

The objective of conducting low visibility operations is to be more **PROFICIENT**. This is achieved by improving upon awareness, knowledge & control of various higher available human-faculties and application of modern aviation technology / avionics. Efficiency has become the most concerning demand in today's era of modern life-style.

This factor of efficiency in regard to airline overall performance, by itself takes care of :

i. Flight safety
ii. On-time performance
iii. Passenger comfort
iv. Economy &
v. The reputation of the operating airline.

This increased awareness to perform satisfactory CAT II / III operations within the prevailing human consciousness would deliver the crew with guaranteed *enhanced professional satisfaction*.

BRIEF EXPLANATION OF VARIOUS CATEGORIES OF OPERATIONS (ICAO)

CAT I Operations **:**
Is a Precision Instrument Approach procedure based upon a decision at an established DA(H) & RVR of :

(i) DA(H) at not lower than 200 ft.
(ii) RVR " " " " 550 mts.

CAT II **Interim / Restricted** Operations **:**
This is a Precision *Approach & Landing* established procedure acceptable to various concerned statutory authorities which ensures a smoother and effective transition to CAT II from CAT I flight operations :
(i) DH not lower than 150 ft. but below 200 ft.
(ii) RVR not lower than 500 mts.

CAT II Operations :

This is a Precision Automatic *Approach & Landing* procedure which caters for a lower DH & visibility conditions which would provide sufficient visual reference at DH and **also** caters with the provision to perform a *Manual Landing*, if required **:**

(i) DH not lower than 100 ft., but lower than 200 ft.
(ii) RVR not lower than 350 mts.

CAT III A Operations :

This is a Precision Automatic *Approach & Landing* procedure which caters for even lower DH & visibility than required for CAT II operations. This would also provide sufficient visual reference at DH **but** an Automatic Landing is Mandatory **:**

(i) DH lower than 100 ft.
(ii) RVR not lower than 200 mts.

With a Fail-Operational Dual System, it is possible to have CAT IIIA operation with DH < 50 ft. (even with no DH, but min. RVR of 200m. is required).

CAT III B Operations :

As in CAT III A, this caters for :

(i) The DH lower than 50 ft. OR No DH
(ii) RVR not lower than 50 mts. (FAA)
75 mts. (JAA)
(iii) ALERT HEIGHT for A-320 aircraft is established as **100** ft., i.e. the FMA display during the approach must be CAT 3 DUAL at 100 ft.(RA). [Fail Operational]

CAT III C Operations :

(i) NO DH minima requirement &
(ii) NO RVR limitation.

Although, this operation is not existing in practice as yet.

ICAO, FAA & JAA CAT II / III DEFINITIONS :

		ICAO	FAA	JAA
CAT II	DH	100ft ≤ DH < 200ft	100ft ≤ DH < 200ft	100ft ≤ DH < 200ft
	RVR	350m ≤ RVR 1200ft ≤ RVR	350m ≤ RVR < 800m 1200ft ≤ RVR < 2400ft	300m ≤ RVR 1000ft ≤ RVR
CAT III A	DH	No DH or DH < 100ft (1)	No DH or DH < 100ft (1)	DH < 100ft (1)
	RVR	200m ≤ RVR 700ft ≤ RVR	200m ≤ RVR 700ft ≤ RVR	200m ≤ RVR 700ft ≤ RVR
CAT III B	DH	No DH or DH < 50ft	No DH or DH < 50ft	No DH or DH < 50ft
	RVR	50m ≤ RVR < 200m 150ft ≤ RVR < 700ft	50m ≤ RVR < 200m 150ft ≤ RVR < 700ft	75m ≤ RVR < 200m 250ft ≤ RVR < 700ft
CAT III C	DH	No DH	No DH	
	RVR	No RVR limitation	No RVR limitation	

(1) DH ≥ 50ft if fail passive

DECISION HEIGHT (DH) RA

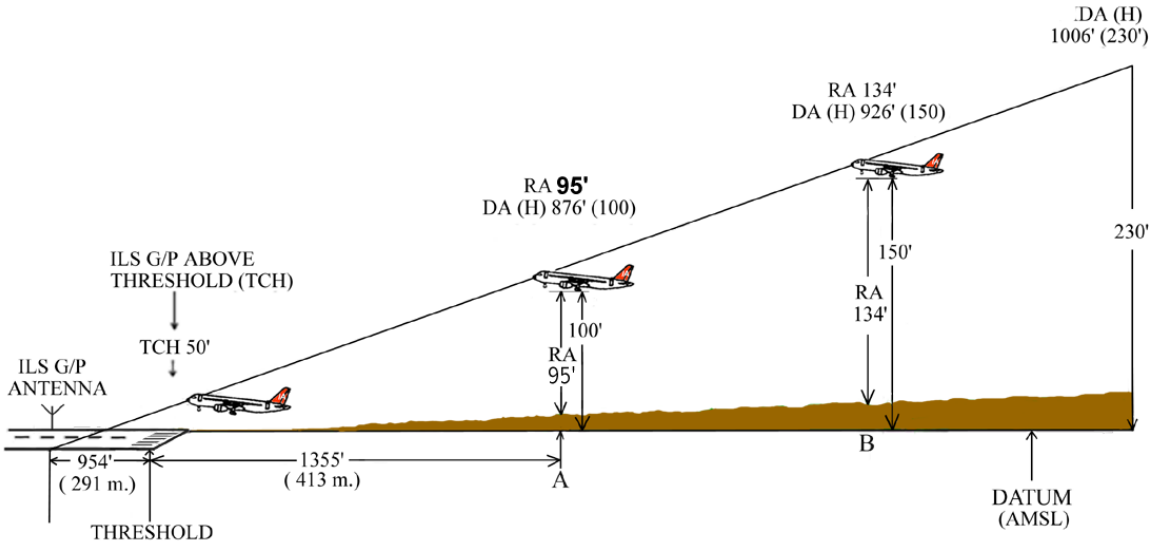
With respect to CAT I operations, Decision Altitude is a reference related to a pressure altitude indication above the runway threshold with a QNH setting on the baro-altimeter, but this is not an accurate method of precise height assessment due to various variables / factors. Hence, a much more accurate method of height measurement referenced as Decision Height is possible by the use of a Radio Altimeter and this is mandatory for CAT II / III operations.

Definition : A specified height in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

DECISION HEIGHT (RA)

This is the airborne Radio Altimeter Height indication at which the pilot has to announce a Decision of < LANDING >, or < GO-AROUND FLAPS > .
The decision to land can only be made at DH when the Visual Reference Required remains established at the Decision Height.

Radio Height/Altitude corresponds to the height of a specified point in space above the surface of the earth measured by a Radio Altimeter. The reference point of the aircraft considered for measurement is the aircraft's main-wheels, i.e. when the lowest portion of the a/c's main wheel height is at 50 ft. above the surface directly below, the RA = 50ft.



Example, VIDP ILS R/w 28 **:** **RA 95'**
DA (H) 877' (100')

When the aircraft is on the ILS approach, an indication of 95 ft. on the Radio Altimeter would correspond to a pressure altitude of 877 ft which is 100 ft. above the runway threshold elevation of 777 ft. as considered. At this point above A, the aircraft is actually 95 ft. above the ground surface because this point A is having a surface which is 5 ft. higher than the runway threshold elevation.

Hence, when the aircraft is on the ILS beam a Radio Altimeter indication of 95 ft would mean that the aircraft is actually 100 ft above the R/w threshold (95 + 5 = 100 ft). This is why, in case of VIDP28, the need is to insert 95 for DH100 in the MCDU perf. page so as to trigger the < MINIMUM > callout at RA95 which corresponds to a DH100 ft.

Similarly, the ground is 16 ft. higher than the R/w elevation at point B, hence an RA 134 ft above B on the ILS beam corresponds to 134 + 16 = 150 ft height above threshold and at this point the baro altitude would be 926 ft. (similarly, 134 will be inserted for a DH of 150 ft). For CAT III operations, for RA 50 & lower DH the a/c is over the runway surface itself hence there is no correction involved.

Explanation of CAT II / III associated terms **:**

- Minimum Descent Altitude (MDA) is a term in use for **non**-precision approaches only. This is the altitude to which the aircraft could descend to during a non-precision approach and could maintain a level flight upto the MAP (missed approach point) before executing a missed approach.

- Decision Altitude (DA) is the pressure altitude as indicated by a **baro**-altimeter, with reference to mean sea level / the threshold altitude as a datum, where the pilot has to **announce** a decision. This is in use with regard to CAT I precision approach.

- Decision Height (DH) is the Absolute Height as indicated by a radio altimeter, with reference to the threshold elevation datum, where the pilot has to **announce** a decision. This is in use with regard to CAT II & III precision approach.

- Radio Altitude (RA) is the Absolute Altitude / Height measured by a Radio Altimeter with reference to a datum of the surface vertically below the aircraft at that particular time.

- *Radio Height & the Radio Altitude is the same thing (popularly known as RA)*

- Touchdown Zone is the first 3000 ft. of the r/w beginning from the threshold. (ICAO) Touchdown Zone Elevation is the elevation of the highest point in the first 3000 ft. of the landing surface. (ICAO)

- Threshold Crossing Height (TCH) is the absolute height of the Glide Slope beam which passes over the designated threshold for a particular runway i.e. shown as TCH 50' for VIDP28. Hence when aircraft is on ILS, the aircraft's Glide Slope antenna (situated in the nose-dome) will be at 50 ft. over the threshold but the main-wheels of the A-320 would be at 34 ft. above, just before the threshold.

ALERT HEIGHT (AH)

The term 'Alert Height ' pertains only to a CAT III ' **Fail Operational** ' Automatic Landing .

The alert height is the height above touch down, above which a CAT3 auto-land would be discontinued and a missed approach executed, if a failure occurred in either the airplane systems or the relevant ground equipments. Below the alert height, if such a failure occurs, the flare, touchdown and roll out may be accomplished using the remaining Automatic system.

The Alert Height established for the A320 is 100 ft.

Explanation of Alert Height (AH) :

This is the Radio Altitude (RA) last deciding ' LIMIT ' above which it becomes mandatory for the dis-continuation of the approach in the event of non-availability of the DUAL- OPERATIONAL system during an approach where it is **mandatory** to have an automatic landing. i.e.CAT3 DUAL must be indicated on the FMA at AH.

1. The ALERT height permits the continuing of the approach below RA 100 ft when there is a requirement to accomplish a 'Fail-Operational Auto-Land, as for CAT III B&C **if** CAT 3DUAL is displayed on the FMA at RA 100 ft.

2. The Alert Height feature is established by taking into account the failure of a technical system integrated to the auto-land system and thereafter the probability of its back-up system failure occurrence also or the failure of another significant integrated system function, all such failures occurring within the last 100 ft. that could affect the safe performance of the [AA/LS] . All these preclusive measures are based upon technical design, experience, evaluation & certification requirement, i.e. whether upon a failure, will the remaining part of the [AA/LS] accomplish a successful landing subsequently below the AH or not.

3. During such an approach if the failure or temporary malfunction occurs **BELOW** the Alert Height, the FMA indication would remain frozen i.e. continue to indicate CAT 3 DUAL and the approach can be continued as the aircraft design capability is such that in spite of the failure/ malfunction, the [AA/LS] would successfully perform an automatic landing using the remaining automatic system **but** there should not be such a type of a failure which would trigger the AUTO-LAND Red warning light.

4. An operator is NOT authorised to establish an Alert Height higher than 100 ft. for the A320, but could have a lower value.

GO-AR CAPABILITY OF A-320

1.The GO-AR capability of the a/c during any phase of the approach is such that it is capable of successful execution of the GO-AR at selection of TOGA.
Even if the wheels make contact with the runway, the auto-pilot will yet accomplish a safe GO-AR and the AP would remain engaged.

2. MINIMUM APPROACH BREAK-OFF HEIGHT (**MABH**)

This is the lowest height above ground in RA, such that if a missed approach is initiated without external references **:**
In normal operation the aircraft does not touch the ground during the GO-AR procedure.
In case with an engine failure during the Go-Around, it can be demonstrated that taking account of this failure probability, an accident is extremely improbable.

The MABH or the altitude loss during automatic GO-AR can be used by company to determine the minimum DH for CAT III operation with DH.

Explanation :

AUTOMATIC GO-AR **:**

A GO-AR executed by the autopilot engaged at TOGA selection would involve a time delay factor as the complete designed process of the system has to be sequentially accomplished.
In case of a very low automatic GO-AR, especially with single-engine, the main wheels may touch the ground but the GO-AR is not affected.

MANUAL GO-AR :

Manual GO-AR is only performed if the decision to GO-AR is taken below DH and after AP has been disconnected.
Otherwise automatic GO-AR is recommended.

A-320 CAPABILITY / CHARACTERISTICS

The A-320 a/c's Automatic System comprises of two aspects**:** Automatic Approach System & the Automatic Landing System, together shown as **: [AA/LS]**

1. CERTIFICATION :
A-320 aircraft certification & demonstrated capability is approved for CAT II & III **'Automatic Approach & Automatic Landing'** operations under all weather conditions.

'Automatic Approach' pertains to the capability of the aircraft to be automatically guided down the ILS beam flown by the aircraft's auto pilot (s) along with the aircraft's associated integrated technical systems & ILS ground equipment systems to perform an automatic ILS approach **but does not** include Auto-Land.

'Automatic Landing' pertains to the capability of the aircraft to perform :

(i) Automatic Approach &
(ii) Automatic Landing / Touchdown & subsequently
(iii) Automatic Roll-Out, with or without auto-braking to a full stop.

2. The ' *FMA Second & Third Column* ' displays the AP guidance modes during the automatic approach / landing. When established on the ILS, this FMA display is GS LOC initially, and subsequently changes to LAND, FLARE, ROLLOUT towards the final stages.

3. The ' *FMA Fourth Column* ' displays the aircraft's " Capability " in regard to its automatic approach & automatic landing at a particular moment during the progress of the approach.
The display is of either CAT1 or CAT2 or CAT3 SINGLE or CAT3 DUAL
The changes in approach & landing capability is decided by the FMGC which takes into account the availability of various aircraft technical systems integrated to the aircraft's **[AA/LS]** at a particular stage. If an associated system fails the capability downgrades, if the system is restored, the capability automatically upgrades back. Whenever a downgrade in capability occurs, a triple click is generated as CLICK! CLICK! CLICK!

4. The ' *FMA FIFTH COLUMN* ' indicates the availability of the number of autopilots, FDs, & A/THR. Whenever there is a change in the fifth column, a triple click is also generated but NOT for any change in regard to FDs since FD is not mandatory for Automatic Approach / Landing.

5. FREEZING OF FMA **:** During the last 100 ft. (RA), the available display on the FMA's ' Fourth Column is frozen. This means that a failure of one AP or a loss of an associated integrated technical / function system would not effect a change in the capability of the aircraft unless LAND mode is disengaged or both auto-pilots are off. This inhibition below the ALERT height is explained in details under Fail-operational dual-system.

AUTOMATIC APPROACH / LANDING SYSTEM [AA/LS]

A-320 a/c **AUTO- APP. / AUTO-LAND CAPABILITY / CERTIFICATION**

The [AA/LS] consists of various integrated single, dual and triple technical systems such as **:**

(i) SINGLE **:** The Auto-Thrust, Anti-skid, DH indication, NWS, etc. etc
(ii) DUAL **:** ELACs, FACs, BSCUs, Autopilots (including 2 Command Channels + 2 Monitoring Channels), FWCs LGICUs, etc. etc.
(iii) TRIPLE **:** ADRs & IRs etc.

In case of a failure of any one part of the above mentioned integrated systems, the capability of the [AA/LS] would get down-graded i.e. if the A/THR or any one ELAC or an ADR fails, a degradation occurs and its capability would degrade to CAT III SINGLE or lower, as the case be.

The following requirement is essential for **'Automatic Landing ' :**
The ILS category of Ground Equipment must be CAT II or CAT III.

At least One AP is engaged / displayed on FMA.

(iii) FMA display must be either CAT2 or CAT3 SINGLE or CAT3 DUAL

(iv) A/THR or Manual Thrust may be used in case of a CAT II Automatic Approach or Automatic Landing.

(v) A/THR must be available and used for CAT III operations

(vi) Both APs must be available for CAT III Fail-Operational System
One AP must be available for CAT III Fail-Passive system
(or depending on company procedure.)

(vii) FDs may or may not be available for CAT II or CAT III operations

(viii) Automatic Landing & Rollout performance is approved on DRY & WET runways. The Auto-Land has been demonstrated at or below MLW (64.5 T)

(ix) CAT II & CAT III Auto-Land is approved for CONF 3 & FULL.

(x) Auto-Land is demonstrated for airport altitude at or below 2500 ft. and for ILS G/S within -2.5 to 3.15^{O}

(xi) Auto-Land Practice with CAT I ILS beam, as mentioned in FCOM 3.01.22 / p4

A-320 CAPABILITY & CERTIFICATION :

The A-320 aircraft capability in regard to aircraft system availability, along with the established state regulation / company procedures would determine the type of ILS category the pilot is authorised to accomplish.

ILS CAT I APPROACH

1. Min MDA 200 ft. & RVR = / > 550 mts.

2. Automatic Approach + Manual Landing is authorised.
   Manual APP + Manual Landing is authorised.
   (except for practice, Auto-land can be performed, refer to conditions as described in FCOM.

3. No AP or One or Both APs may be engaged but if any auto- pilot is engaged, it must be disconnected latest by 160 ft. AGL (except for Auto-Land practice)

4. FMA 4th Column display must be CAT1 or CAT2 or CAT3 or CAT3
   SINGLE DUAL

5. The FMA 5th Column display may be no AP or AP1 or AP 1+2

6. A/THR may or may not be used, i.e. its serviceability is not mandatory

7. FDs may or may not be used, i.e. its serviceability is not mandatory.

8. LOW VISIBILITY PROCEDURE (LVP) for the respective airport is not mandatory but in case of Auto-Land practice, ATC must be informed.

ILS CAT II

1. Min. DH 100 ft. Min. RVR = / > 350 mts.

2. Automatic App + Automatic Landing is permitted.
   Automatic App + Manual Landing is permitted.

   If Manual Landing is to be performed with a pre-intention, the AP must be disconnected latest by 80ft.(RA)

3. At least One or Both APs must be engaged for the Auto-App. or Auto-Land.

4. FMA 4th Col. display must be CAT2 or CAT3 or CAT3
   SINGLE DUAL

5. FMA 5th Col. display must be AP 1 or AP 1+2

A/THR may or may not be available i.e. availability is not mandatory.
FDs may or may not be available i.e. availability is not mandatory.

LOW VISIBILITY PROCEDURE (LVP) at respective airport must be in-force / activated. Necessary confirmation & approval from ATC **is required**.

ESTABLISHMENT OF VISUAL REFERENCE at DH requires the pilot to be able to see and identify at least 3 segments of the Precision Approach Lighting System. Thereafter, till touchdown the pilot must also be able to maintain sight of a visual reference of at least 3 segments as mentioned in Visual Reference Required.(page 34)

ILS CAT III A 'FAIL PASSIVE SINGLE' Automatic App. / Ldg.System [AA/LS]

Min. RVR = / > 200 mts.

Automatic Approach + Automatic Landing only.
* For CAT IIIA, in case of a system failure, the AP can be disconnected at touchdown if the visual reference required is established, or as per company procedure.

3. At least ONE AP (for DH >50 ft.) or Both APs (for DH < 50 ft.) MUST be engaged and an Auto-Land must be performed.

4. FMA 4th Col. display must be either CAT 3 SINGLE or CAT 3 DUAL
(or as per company procedure.)

5. FMA 5th Col. display must be either AP 1 or AP 1+2 & A/THR or as per company procedure established.

6. A/THR MUST be serviceable and available

7. FDs may or may not be available. i.e. availability is not mandatory.

8. LOW VISIBILITY PROCEDURE (LVP) at the respective airport must be in-force / activated. ATC confirmation and approval **is required.**

9. Establishment of VISUAL REFERENCE at DH, remains same as for CAT II. (refer visual reference required, page 34).

* this is only in case of a technical failure where the pilot feels it possible to accomplish a manual landing confidently, because if RVR reported is 200 m., the SVR would also be about 200 m. at touchdown height and about 5 light segments would be in view here.

CAT III B FAIL-OPERATIONAL DUAL [AA/LS]

Min. DH 15 ft. or NO DH ; RVR 75 mts.

ALERT HEIGHT = 100 ft.

AUTOMATIC APPROACH + AUTOMATIC LANDING ONLY

Both APs must be available and engaged.

5. FMA 4th Col. must display CAT 3.
   DUAL
6 FMA 5th Col. must display AP 1+2 & A/THR

7 FDs may or may not be available i.e. not mandatory.

8. LOW VISIBILITY PROCEDURE (LVP) for the respective airfield must be in force / activated and ATC confirmation and approval **is required.**

EXPLANATION :

CAT III FAIL-OPERATIONAL **DUAL** **[AA/LS]**

The A-320 aircraft is equipped with a DUAL [AA/LS] which comprises various technically integrated single, dual & triple aircraft technical systems and functions as mentioned in page 21, required for the automatic landing and its associated guidance**.** The [AA/LS] is classified as a **Fail-Operational dual** system when all requisite single, dual & the triple integrated aircraft systems are functional / available. This would be confirmed by a CAT3 DUAL indication on the FMA.

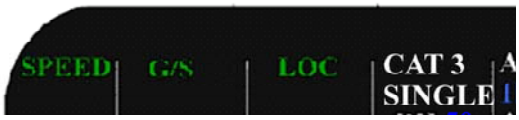
This Fail-Operational system is mandatory for CAT III with DH <50 ft. or No DH. The ALERT height for the A-320 is established at 100 ft.(RA).

The certification requirement in regard to the conduct of a CAT III with DH <50 ft. or No DH operations is such that CAT3 DUAL must be displayed on the FMA at the Alert Height i.e. the [AA/LS] must be fail operational at 100 ft.(RA).

If any [AA/LS] integrated technical system / function fails or is not available, the capability of the [AA/LS] would DOWNGRADE to a lower capability and the FMA would display CAT3 SINGLE or CAT2 or CAT1 depending upon the extent of the non-availability of the related systems / function.
When the [AA/LS] is operating as a Fail-Operational system, if any relevant technical system(s)/ function becomes inoperative above the Alert height, a CAT III with DH <50 ft. or No DH approach / landing cannot be accomplished unless the system restores itself back operational i.e. the FMA again displays CAT3 DUAL at or before the Alert height. But, if the said relevant technical system(s) / function failure occurs BELOW the Alert height, CAT3 DUAL would remain displayed (frozen), the operation can be continued and the [AA/LS] will guarantee a successful automatic landing.
Here the Logic is based upon the probability factor in regard to failure of the back-up system also or a similar redundant system failure occurrence. The [AA/LS] system design, experience, & evaluation process is such that it is very certain that the probability of two such failures occurring simultaneously during the last 100 ft. is extremely remote. i.e. with CAT3 DUAL, if ELAC1 failed below 100 ft.(RA), the chances for the ELAC2 to also fail in the next few seconds is extremely improbable.(or some other integrated technical system / function to fail also along with its backup, during the short transition of the aircraft from 100 ft.RA to touchdown).
Hence the system design is such that, on an occasion, where an integrated system or function fails below Alert Height, the capability display of the [AA/LS] would remain unchanged, the FMA would continue to display CAT3 DUAL and approach could continue with an automatic landing, **but** the Auto-Land fail red warning light must not appear.
The judgment & decision on part of the pilot below Alert height is very critical when a system failure occurs, the [AA/LS] capability with CAT3 DUAL is such that the pilot is more relieved and confident of a successful auto-land as the pilot has to only bear in mind the VRR / visual cues and monitor the red Auto-Land light.

At the ALERT HEIGHT RA 100, the PF must confirm CAT3 DUAL indication on the FMA in order to decide / announce < LANDING > or < CONTINUING >.

CAT III FAIL- PASSIVE **SINGLE** [AA/LS]



In this case, during the approach or earlier the [AA/LS] capability of the a/c had already down graded due to failure / non-availability of some integrated technical system(s) / function. The FMA would be displaying CAT3 SINGLE. Subsequently, if any integrated technical system / function fails at any time there is no further [AA/LS] technical back-up available in this case as it was in the case of a Dual-Operational system

The aircraft is certified and capable to conduct an ILS CAT III A with DH > 50 ft. or a CAT II i.e. an Auto-approach & Auto- landing can be accomplished with a Fail-Passive system but the only draw-back is that say, if a malfunction occurred during the flare, the [AA/LS] may not be able to accomplish the remaining portion of the flare, landing or roll-out satisfactorily depending upon what has failed, hence the pilot would have to be ready as a back-up to immediately take-over manually.

AUTO-LAND RED WARNING FLASHING LIGHT

The Auto-Land RED flashing light on the glare shield would indicate that the Auto Land feature / capability of the [AA/LS] CAN NOT perform an Auto-Land.
The pilot will have to accomplish a GO-AR.*

Important :
DO NOT mistake this RED auto-land light with the RED Master Warning light. This light is in front of the left eye and when triggered it will **not** be accompanied along with the Mas. Warning / CRC. The Master Warning red light which is accompanied with CRC is in front of the right eye. It may so happen that you get a red flash of the Mas. Warning i.e. engine fire etc at just below DH when you are intensively concentrating for visual cues, at this critical stage instead of continuing and landing you unnecessary carry out a GO-AR assuming the Auto-Land system has failed due to a red flash in front of the eyes. A triple click is also generated whenever the Red A/Land light flashes.

The RED Auto-Land fail warning light can only get triggered when the aircraft is **below 200 ft. (RA)** and if any of the following occurs :

(a) Loss of Both Auto-pilots.

(b) The aircraft gets too far off the ILS beams :
in case of LOC deviation > 1/4 DOT when above 15 ft RA or
in case of GS " > 1 DOT " " 100 ft. RA.

(c) The LOC or G/S Ground Transmitters failed.

(d) The LOC or G/S Airborne Receiver failed.

(e) If difference between both RA > 15 ft.

*If the Auto-Land RED light flashes before DH, a GO-AR becomes MANDATORY unless the visual references are sufficient for manual landing.
For a CAT II approach, a manual landing decision could be made if the red light flashes below DH with visual reference required already established and the pilot feels it comfortable to land, or as per the company procedures.

CAT II / III PRIOR ASSESSMENT

COMPANY MINIMA FOR LOW-VISIBILITY OPERATIONS :

Check and discuss the company policy & minima governing low-visibility operations for the particular airfield where CAT II/III operation is to be executed.

For **Indian Airlines ltd**. (IAL) the following policy is governing **:**

(i) Touchdown- RVR & Mid- RVR reports are mandatory for Cat II & III operations.

(ii) The lowest of the three RVR s i.e. TOUCH-DOWN- RVR, MID-RVR & ROLL-OUT or the STOP-END RVR is the controlling factor.

(iii) When Stop-End / Roll-out RVR is not available, the lower of the other two is controlling.

(iv) A flight cannot proceed to destination if the visibility at destination is below minima without a trend for improvement. The forecast Met. conditions at either the destination or at least one alternate should at the ETA be at or above the AOM (aerodrome operating minima). The minima applicable for CAT II/IIIA shall not be considered as AOM for this purpose.

(v) **Continuation** of APP: As per DGCA India, an Approach may not be continued if the weather reported is below minima. Hence, at any stage during approach up to DH if RVR reported is below minima a missed approach must be initiated.
The Approach Ban policy / criteria does not apply for IAL.

DESPATCH BRIEFING

1. Check company procedure for dispatch of a flight to a destination with a forecast for low visibility (chances for CAT II / III conditions) & alternate requirements.
2. Confirm availability of ILS CAT II / III facility at destination.
3. Check alternate weather and availability of approach facility.
4. Consider extra fuel requirement for slow-traffic sequencing in case of CAT II / III operations. (at least 2 tons extra for VIDP & if load permitting uplift even more.)
5. Check NOTAMS for any significant aspect.
6. Check status of aircraft., check with maintenance for auto-land test.
7. Check for crew qualification / recency.

Indian Airlines ltd. -- ILS CAT I MINIMA : GOC DT/GEN/ I-118 **:**
The touch down RVR will be the controlling RVR, which should be equal to or above the specified minima. The MID RVR, if available should not be less than 50% of the Touch Down RVR or 350 mts, whichever is higher. MID RVR is not mandatory for CAT 1 operations.

VISUAL REFERENCE AVAILABLE (VRA)
&
VISUAL REFERENCE REQUIRED (VRR)

VISUAL REFERENCE AVAILABLE (VRA)
This is the appearance of the Precision Approach Lighting System (PALS) available for the pilot to sight at the DH i.e. what the pilot can expect to see in regard to the portion / segment of the PALS or runway lighting or markings depending upon the prevailing RVR / SVR conditions at the respective DH.
The VRA would depend on the DH and the RVR as explained for each category later.

VISUAL REFERENCE REQUIRED (VRR)

The next aspect is, what is the visual reference **required** criteria established by the regulatory authorities for a pilot to decide < LANDING > at DH i.e. how many light segments of the PALS or of the runway lighting /markings the pilot MUST be able to see & identify before making a decision of < LANDING > ?

As described under meteorological chapter, it is very difficult to predict the type of fog prevailing at a particular time especially during winter in Delhi. With past experience it has been noticed that a Matured Fog usually prevails at most of the time during winter where the density of the fog layer increases with height above ground at an inconstant rate & characteristics / properties.

The following 3 aspects are required for the pilot to make proper Judgment & Decision :

1. Results from extensive human research, simulator and actual flight tests have exhibited that **a pilot requires about three seconds** for " *recognition & identification* " upon establishing first visual contact with the related segment of the PALS, associated runway lights / markings, in order to make proper *judgment.*
Hence the pilot must achieve visual contact with the required visual reference by about **30 ft**. prior to arriving at the DH.

2. In addition to the 3 seconds prior to DH sighting of the VRR as explained in para 1, it is also an established fact that a pilot in requirement to natural human senses, would also require to have**, at least 3 light / marking segments in view** for the purpose of "C*orrect Orientation Perspective*".

This aspect of human-awareness is essential for proper assessment of the flight path in regard to the lateral, directional and vertical planes so as to enable a pilot make proper judgment.

ORIENTATION *is the difference between Positional Awareness and Potential Confusion.*

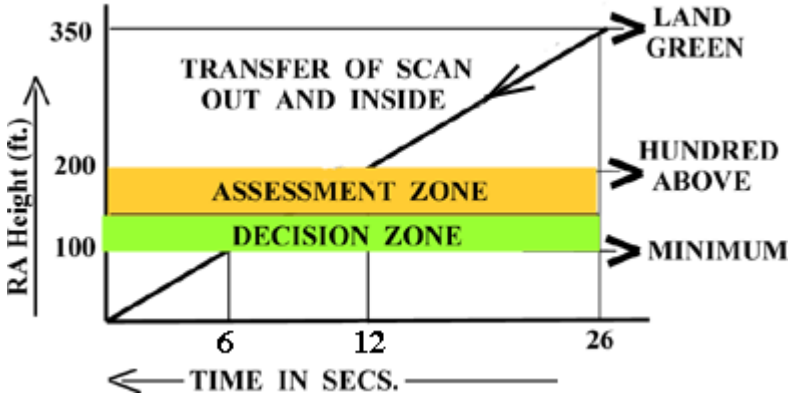
3. Within the decision zone the following aspects must be satisfied for the pilot to announce < LANDING > decision at DH :

(i) good quality of the a/c flight path,
(ii) satisfactory performance of the aircraft on the ILS beam and
(iii) adequate outside visual cues, i.e. the VRR must be established.

UNDERSTANDING ASSESSMENT / DECISION ZONES

ASSESSMENT ZONE :

This commences at the " Hundred Above" callout. Hereafter the pilot is required to be



only looking outside for visual cues making an assessment of the situation.

DECISION ZONE :

About 3 seconds after the "HUNDRED ABOVE" callout, the flight enters into the Decision Zone before which the PF has already made an assessment of the situation outside. Now, here the PF is required to judge & decide within the next 2 seconds i.e. by DH and announce the decision correctly at the < MINIMUM > callout.

The duration of the decision zone is for about 2-3 seconds and the lower last limit of the decision zone is at the < MINIMUM > callout. **Hence pilot must achieve visual contact with the VRR by about 3 secs./ 30 ft prior to reaching the DH.**

[In case of CAT II & III operations, duration of the Assessment / Decision Zone is about 5-7 seconds. i.e. after the ' hundred above ' callout, the PF will have about 5-7 seconds to assess the situation and announce a decision at the <minimum> callout.]

PRIMARY OBJECTIVE OF VRR

Definition :
The visual reference required (VRR) means the visual aids of that section of the runway or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position, in relation to the desired path.

In regard to the requirement as to how many LIGHT SEGMENTS the pilot must be able to *see & identify in order to decide < LANDING > at DH* would remain the same criteria as been accepted and established by various statutory authorities based on experience over the past several decades **:**

The concerned authorities have decided that a minimum of **' 3 LIGHT SEGMENTS '** of the associated portion of Precision Approach Lighting System (PALS) MUST be ***seen & identified*** as applicable for the respective DH in order for the pilot to announce the decision of < LANDING >.
(3 Segments mean three longitudinal segments)

SECONDARY OBJECTIVE OF VRR

Further, the requirement is that the pilot must thereafter throughout the approach / Flare also continue to see up to the touchdown, at least 3 Segments of either **:**

(i) The Precision Approach Lighting System, **or**

(ii) The runway touchdown zone lights (barrettes) / markings,
[including the runway beginning / threshold green bar as one segment] **or**

(iii) **The runway centre-line lights**, **or**

The runway edge lights.

Note: **In case of CAT II & IIIA, the pilot must positively identify the glow of the green BAR of R/w threshold lights & subsequently the R/w Centre-Line & TDZ Barrettes in order to confirm proper position to prevent any misjudgment due any possibility of a false / erroneous G/S or a deflected LOC beam.**
Whereas in case of CAT IIIB, the pilot must be able to IDENTIFY the R/w Centre-Line Lights & if possible the TDZ Barrettes positively.

CHANGE OF DECISION :

to the fact that, as the flight progresses below The requirement for a continuous ability of pilot to see 3 visible segments is due reason the DH it could happen that a pilot may encounter a thicker layer / patches of fog and may lose sight of the required reference of 3 light / marking segments any time before the touchdown.

In such a case the PF would have to change the decision to < GO-AROUND FLAPS > and would have to execute a go-around immediately.

Recommendation of Airbus Industrie :

After having announced " LANDING " it is not a good idea to perform a GO-AR for a **temporary reduction** of required visual references when you are going to make an automatic landing and rollout. This is left at pilot discretion as the Airbus Industrie considers this aspect as not a requirement in the regulations but a GO-AR would become mandatory if a manual landing is anticipated. Moreover, identification of fog patches from a permanent blinding feature of a thick lower level fog-layer must be made by the pilot to help make a better judgment & decision at this critical phase of flight

CAUTION

Improper / unscreened high tension wiring system of vehicles or equipment / devices plying in close proximity to sensitive areas could affect the optimum performance of the ILS ground signals or a/c avionics system thereby resulting to generate erroneous signals.

It may so happen that the pilot decided <LANDING> by seeing a few lights at DH but that does not rule out the possibility of sighting the 'Wrong Visual Cues'. Pilot must sight the correct portion of the associated PALS in relation to the respective DH and subsequently also observe the appropriate LIGHTS as the a/c descends further. Hence the pilot still has about 9 secs (for CAT II) to correct a wrong decision by positively identifying the correct positioning of the a/c instead of simply allow a touchdown based on blind presumptions.

Especially for VIDP28 where a highway exists in close proximity, it is very essential that the appropriate portion of the PALS, the green threshold bar lights and thereafter the R/w Centre-Line Lights & TDZ barrettes be positively identified before deciding / allowing the touchdown.

' TRANSFER OF VISION ' :

During the Take-off Run & the Landing-Roll the Primary Reference for directional Guidance & Control on ground is the R/w Centre-line Lights.
The PF is to be looking out at the R/w Centre-Line Lights for directional Guidance & Control but during an encounter with a FOG PATCH, the PF will have to transfer vision at the **YAW-BAR** for guidance.

HENCE :
Brief the PNF that in case outside visual reference is lost due to fog-patches etc., you will call out " ***Transfer of Vision*** " and transfer your attention inside at the yaw bar for directional Guidance & Control and the PNF should immediately start looking outside for visual cues and call out " ***visual reference available***" once the a/c is clear off the patch so that the PF can revert attention back outside for directional Guidance & Control

CAT II

(Interim / Restricted Operations) :

DH 150 ft. ; RVR 500 mts.

VISUAL REFERENCE AVAILABLE :

1. For interim operations, as shown in the 'Appearances' on page 67, the visual presentation is based on theoretical calculations and the fact that the FOG layer would be an IDEAL Fog Layer somewhat like shallow-fog, with an almost unified presentation all around the airport and approach area. The RVR would be of a uniform value of 500 mts. spread all around i.e. the RVR = SVR.

Under this condition of availability, the pilot at DH would be able to see 11 segments of the Approach Lighting System out of which the second & third 'Cross-Bar' would also be visible, as shown.

2.As explained above, the scenario may not be so because of the fact that the fog may not be an ideal fog layer i.e. in which case its density may increase with height above ground, as in case of matured fog.
Although with the RVR reported as 500 mts. the actual factor that would effect the pilot vision is the SVR. So to convert the RVR to SVR a factor of 58% is involved, hence RVR 500 x .58 = SVR 290 mts.

Hence, in this case, the pilot at DH would be able to have a visible slant range of only about 290 mts. instead of the reported value of RVR 500 mts.

In 90% probability, chances would be that the pilot would actually have a vision range of equal to or MORE than this derived value of 290 mts., how much more? would depend upon the characteristics of FOG. As per experience, it is observed that the SVR would always be more than this theoretical value of 290 mts.

With reason to this aspect of SVR, the pilot would be able to positively see about 4 to 7 light segments, instead of the 11 light segments.

Hence the available visual reference at DH 150 ft. ; RVR 500 mts., would be a minimum of about 4 light segments of the approach lighting system.

For details regarding the geometrical / trignometrical calculations, refer APPENDIX II page 71.

….. contd.

… contd.

VISUAL REFERENCE REQUIRED :

The concerned authorities have decided that a minimum of '3 LIGHT SEGMENTS ' of the associated PALS MUST be *seen & identified* at DH in order for the pilot to decide < LANDING >.

1. Further the secondary requirement is that the pilot must thereafter throughout the approach also continue to see up to the touchdown, at least 3 Visual Segments of either :

(i) The precision approach lighting system (PALS)

or

(ii) The runway touchdown zone lights (barrettes) / markings,
(including the runway beginning / **threshold green bar** as one segment)

or

(iii) The runway centre-line

or

The runway edge lights.

2. If the pilot is unable to establish the required visual reference of 3 light segments of the Approach Lighting System at DH, or loses sight of the reference required below DH the pilot may have to announce < GO-AROUND FLAPS > and execute a GO-AR.

NOTE :

After having announced " LANDING " it is not a good idea to perform a GO-AR for a temporary reduction of required visual references when you are going to make an automatic landing and rollout. This is left at pilot discretion as the Airbus Industrie considers this aspect as not a requirement in the regulations. A GO-AR would become mandatory if manual landing is anticipated

3. The pilot CAN NOT decide < LANDING > at any stage prior to arriving at the DH although visual contact with a good number of light segments may have been established at any height above the DH. This is because there is a good possibility for the pilot to again lose visual contact of them shortly before DH, the decision has to be made only at DH.

Moreover, for CAT II operations / low-visibility conditions it is recommended to perform an auto land instead of a manual landing whenever possible.

CAT II

DH 100 ft. ; RVR = / > 350mts.

VISUAL REFERENCE AVAILABLE :

1. For CAT II operations, appearance of the PALS at DH would be as shown in page 68. This presentation is based upon theoretical calculations of Ideal Fog, as explained earlier, where the RVR = SVR = 350 mts.
Under this condition, the AVAILABLE visual reference at DH 100 ft. would present the pilot to see about 7 segments of the PALS, out of which only the first CROSS-BAR would be visible, as shown.

2. Considering the non-ideal conditions, i.e. where the fog density increases with increase of height above ground, although the RVR value is 350 mts. the factor that would actually affect pilot vision is the SVR.
To convert RVR 350 m to SVR a factor of 68 % is involved :

RVR 350 x .68 = SVR 238 m.*

Hence with reason to this aspect of SVR, the pilot would be able to see about 3 to 5 light segments (barrettes) only, instead of the 7 segments.

(* The probability factor of 90 % chances is that the pilot may be able to have an SVR of 238 mts. or more.) Experience shows, the SVR would be more than this theoretical value. For details in regard to the calculations, refer to APPENDIX III page 72.

VISUAL REFERENCE REQUIRED :

As explained earlier in regard to the ' required visual reference ' for the interim/restricted operation, in this case of standard CAT II operations also, the pilot MUST be able to see & identify at least 3 segments of the approach lighting system (barrettes). Subsequently below the DH also the pilot must be able to remain in visual contact with at least such 3 visible segments, as mentioned for interim operations.

NOTE : After having announced " LANDING " it is not a good idea to perform a GO-AR for a temporary reduction of required visual references when you are going to make an automatic landing and rollout. This is left at pilot discretion as the Airbus Industrie considers this aspect as not a requirement in the regulations. A GO-AR would become mandatory if manual landing is anticipated.

It is recommended to always perform an auto-land for CAT II operations / low-visibility conditions, whenever possible.

CAT III (A)

DH 50 ft. : RVR 200 mts.

VISUAL REFERENCE AVAILABLE :

1. For CAT III A operations, the appearance of the lighting system at DH would be as shown in page 69.
This is again based on theoretical calculations of Ideal Fog, as explained earlier, where the RVR =SVR = 200 mts.

Under this condition, the Available reference at the DH would present the pilot to be able to see about 4 light segments, out of which 2 segments would be of the approach lighting system, 1 segment as the runway threshold green lights (bar) and 1 segment of the runway touchdown barrettes, as shown.

2. Considering the non-ideal conditions, as explained earlier, the factor that would actually effect pilot vision is the SVR aspect. Here a factor of about 77 % is involved.
Hence RVR 200 mts. x .77 = SVR 154 mts.**

With reason to this aspect of SVR, the pilots may be able to see about 2/3 light segments.

(** the probability factor of a 90 % chances is for the pilot to be able to have an SVR value of 154 mts. or more)

For details of the calculations, refer to APPENDIX IV page 60.
For more comprehensive CAT 3 operations, refer to CAT 3 WISDOM brochure.

VISUAL REFERENCE REQUIRED :

For this type of CAT III operations also, the pilot MUST be able to see & identify the runway threshold green lights (bar) and / or at least 3 * light segments of the Runway Centre-Line or touchdown zone lighting / barrettes or runway markings.

*As per JAR-OPS, only ONE light segment is required.

SECTION III

FLIGHT PROGRESS / TECHNICAL MODALITIES
&
ASSOCIATED PF/ PNF RESPONSIBILITIES

CREW CO-ORDINATION & UNDERSTANDING

CAT II / III operations require a proper crew understanding and a perfect co-ordination. The callouts required from the PNF is very important and to every callout of the PNF, the PF must acknowledge with < CHECKED > so that the PNF is aware of the alertness of the PF (or in case of subtle incapacitation). There is a great need to re-emphasize the importance for a perfect crew co-ordination to effect a good result.
The PNF must desist the temptation to look outside during the approach / landing.
(After the MINIMUM auto-callout, there is no need for the PF to continue acknowledging < CHECKED > to subsequent auto callouts as it becomes too excessive)

PILOTS' RESPONSIBILITIES

Both the pilots have their own areas of responsibilities which have to be dedicatedly performed with the utmost perfection of human capability.
In this section, the LVTO (Low Visibility Take Off) & the complete CAT II approach / landing phases are described in the best possible way for the pilots to understand the associated technical modalities in respect to flight progress and PF / PNF duties.

LOW VISIBILITY TAKE-OFF (**LVTO**) **:**

1. For a LVTO, the primary lateral guidance is the external visual cues but the assistance of the Yaw-bar can be used in case of unexpected RVR reduction.

2. Whenever performing a low visibility take-off it is wiser to use TOGA power and the highest flap setting possible so as to achieve the earliest lift-off with the minimum ground-run distance & time.

3. Select the ILS pb ON so as to have the LOC index available on PFD, ensure the ILS Freq./ CRS on the Rad.Nav. page is correct. This is so done because, if the FD fails the **YAW-BAR** which is an integral part of the FD will also not be available and the pilot can use the LOC beam as a reference to remain on the R/w center-line if a fog patch is encountered either during the T/O run or during the RTO phase.

(Selection of the Rose ILS on ND would make things even more simpler as every pilot is used to this way of maintaining on LOC signal whereas the selection of Rose Nav or Arc mode would be of no value when there is such an uncalled requirement due FD failure.)

4. When Take-off power is applied, the FD bar is replaced by the presence of a **YAW-BAR** to provide directional guidance during the Take-off run. In case you happen to encounter a fog-patch, the Yaw-Bar is the most vital aid, just follow the command with gentle rudder inputs when the external visual runway / lights cues gets obscured.
With both engines operational, there is no problem in keeping the Yaw-Bar in the center. As the aircraft speed increases lesser amount of rudder input is needed.

ENGINE OUT DURING TAKE-OFF :
If an engine failure / fire occurs before V1 where the Take-off has to be rejected, retard the thrust levers back to IDLE ONLY. DO-NOT use Reverse Thrust of the live engine because an ASSYMETRY of power would set in and if a fog-patch is encountered where total lateral / directional guidance and control would depend on the yaw-bar, it would be difficult to maintain the directional control as a large differential rudder-cum-brakes inputs would be required at an inconstant & variable rate depending on several aspects.

There would be a very large scope for the aircraft to go-off the runway and its associated problems, whereas if the reverse thrust is not selected the auto-brake feature and the spoilers are certified and good enough for a deceleration up to a complete halt. Similarly, when landing with one engine out. However, in regard to the above, the RTO procedure / technique is entirely upto the Pilot's discretion, i.e. the pilot can resort to the best possible way as deemed fit depending upon the situation.

6. It is emphasized that during a LVTO the primary guidance for the pilot is the runway **center-line lights**.

7. ' **TRANSFER OF VISION** ' **:** Brief the PNF that in case outside visual reference is lost due to fog-patch etc. you will call out " *Transfer of Vision ",* as explained on page 35.

8. HEELS ON FLOOR **:** Remind yourself to make yourself aware that you have to let the heels of your feet remain on the floor in case of a RTO so as to not unconsciously raise them up to disconnect the Auto-Braking.

IN-CRUISE DISCUSSIONS

When CAT II conditions are expected to prevail at the destination, both pilots must have the following discussions during the cruise.

1. A/C STATUS **:** Check the aircraft status for INOP systems. If any doubt regarding performance of any auto-land integrated system, decide the limit up to which you could continue before reverting to a decision of a higher minima as applicable under company procedure.

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2. WEATHER & FOB **:** Check and discuss the destination and alternate(s) weather as applicable to the type of ILS category to be accomplished. The company minima and procedure must be kept in mind. Extra fuel would be required bearing in mind that a low-vis. conditioned airport is bound to have several aircraft traffic ahead of you also perhaps carrying out CATII/III approaches and that it takes more time for the ATC control system to sequence the various traffic for approaches during low-vis conditions. The alternate Wx must be equal to or better than CAT I conditions with a trend of improvement otherwise have a second alternate. If desired a change of designated alternate be considered accordingly

3 MINIMA **:** Check and review applicable company minima for the type of ILS approach category.

4. IAL PROCEDURE **:** Review the charted IAL/ let-down procedure in detail. Check and review STAR involved or any special ATC requirement. For a CAT II/III approach, a pilot must have more of a GO-AR frame of mental- preparedness rather than for landing (i.e. the undesirable aspect of firm human-commitment of get-homeitis pre-conditioning of mind must be avoided).

ATC APPROVAL **:** Upon first contact with the destination airport, check with ATC and confirm the availability and status of the type of ILS category desired. Request ATC for about 10 nm positioning on the finals. Once cleared for the low-vis approach, do not oblige to accommodate ATC requests for adjustments unless there is an urgency.

6. CREW QUALIFICATION **:** Check both pilots are competent and qualified for the proposed CAT II / III operation

7. Approach Ban **:** If the reported RVR drops below minima after crossing the LOM, the approach can be continued to DH, or as per company procedure.

8. Review of Task sharing, as per FCOM, any special item can be also discussed.

9. Review of significant Technical malfunctions.

10.Have a glance of the Appearance of VRA for the ILS category proposed.

11. COCKPIT LIGHTING & EXTERNAL LIGHTS :

Discuss the use of cockpit and external lighting. The pilots must get adapted to the right cockpit illumination environment suitable for CAT II operations well before commencement of the approach. The cockpit lighting be kept to the lowest degree of brightness as far as possible because the human-optics / ophthalmology by nature in regard to time-adaptation to change & orientation factors is such that the best transfer of vision and its associated recognition-cum-instinctive reaction is optimum when both levels of lighting intensities, outside and inside the cockpit remain the same.
This would matter mainly during night. During morning/daylight fog operation the cockpit would have already been lit-up by almost the same value of ambient brightness.

The external lighting of the aircraft must be kept off as far as practicable especially during night operation except the navigation lights. This is to prevent any reflection and illusory effects on pilot eye / senses as explained under Meteorological Factors chapter.

12. CABIN-CREW BRIEFING :

It is very important to caution the cabin-crew of various important aspects such as :

Not to disturb below 10,000 ft. (maintain sterile cockpit)

Once signaled for landing, the c/crew must not make further communications and advisories with the cockpit crew either on inter-com. or through person. Only in case of an urgency, the same may be made through the intercom system.

Advise cabin-crew to ensure all mobile phones / electronic devices are positively switched off.

13. LOCK Cockpit Door :

It would be wise in fact to lock the cockpit door so as to prevent any intrusions into the cockpit thereby avoiding any chance of uncalled light exposure to pilots, or due to the cockpit door opening on its own during approach or at deceleration after touchdown, as it does happen at times.

14. TRANSFER OF VISION :

Brief the PNF that in case outside visual reference is lost due to fog-patch etc. you will call out " *Transfer of Vision ",* as explained on page 35.

AUTOMATIC APPROACH & LANDING

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PF DUTY

The PF & PNF are to monitor their respective instruments. The PF will also monitor the availability of Auto-callouts which commences at 400 ft. RA and LAND green appear on the FMA at about 350 ft RA.

PILOTs' INSTRUMENT SCAN

The scan-flow requires increased awareness faster judgment and the right decision to meet the higher professional demand of CAT II operations.

(i) From the commencement of the approach the PF must have the left hand on the side-stick & right hand on the thrust levers, ever ready for an appropriate action. The feet must be down with the heels on the floor to avoid any inadvertent brake application at touchdown thereby disengaging the Auto-brakes. The same philosophy is valid for prior to a low-vis take-off.

(ii) During the approach, both Pilots' scan must be very effective.
Scan the PFD for FMA, Speed, FD bars, a/c pitch attitude, RA, altitude, GS, LOC, Hdg., Track(green diamond), correct ILS course. Observe the ND for winds, LOC & GS.

(iii) Monitor the Engine Instruments for any abnormal parameter behavior.

STANDBY HORIZON

Before commencement of the approach check the STBY HORIZON for no Red flag. Later on the pilot is supposed to use it only in case of ATT. disagree.

(Notice the position where the flag will appear in case of an instrument failure).

APPROACH PREPARATONS (10,000 Ft)

The Standard Briefing & Callouts for instrument approaches all pilots are already familiar & aware of which is also prescribed in the company's operations manual (SOPs) & FCOM.

Check the latest aircraft status regarding the INOP systems.
Check with ATC regarding CAT II / III availability & whether LVP in-force.
Check correct pilot seat position (MOSP)
Select Auto-brakes to low preferably, or according to runway length or condition.
LOCK the cockpit door.

CAT II BRIEFING :

For CAT II operations the briefing becomes more specific and to the point as it is expected that the pilots have gone through the IAL chart in detail during the cruise so only emphasize on the main aspects now.

1. Final App.Alt.2600'; Inbound 284^{o} ; 95 inserted for a DH 100 & GO-AR procedure is **…..**

2. PF to PNF =>

(i) " In case there is no response / acknowledgement from me to your two consecutive callouts, you can presume my subtle incapacitation. You will immediately confirm & initiate a GO-AR

(ii) You will remain & maintain head-down to monitor the instruments during the entire approach, landing and to the end of the roll-out, and call-out :

1000 ft & 500 ft (AGL) ..... Baro-altitude

(LAND GREEN is a PF callout)

FLARE OR NO-FLARE

ROLLOUT

GROUND SPOILLERS, REVERSE GREEN, DECEL

IF NO AUTO-CALLOUTS, YOU WILL CALLOUT HUNDRED ABOVE
&
MINIMUM ".

NORMAL SEQUENCING OF APPROACH / LAND PHASE AND ITS ASSOCIATED PF / PNF DUTIES AND RESPONSIBILITIES

COMMENCEMENT OF APPROACH

The a/c is on the ILS CAT II beam, the FMA indications available to the pilot would be as shown when a/c is below 1000 ft.(AGL).

AUTO CALLOUTS

The Auto-callouts commence at 400 ft. as :

Four-Hundred ;Three-Hundred ;Two-Hundred ;
In case of RA 95 ft for VIDP R/w28, the call after two-hundred would be
HUNDRED ABOVE (at RA195') ;
ONE HUNDRED ;
MINIMUM (at RA 95') followed by
FIFTY ; THIRTY ;TWENTY
At RA10' – RETARD, with AP engaged or at RA20' without AP engaged.

Note : Depending upon the V/S (or slight wind-shear etc.), the auto-callout of One-Hundred at VIDP may not be available as it is too close to the Minimum auto callout for 95 ft RA as both these 'one hundred & minimum callouts' may merge together so it becomes more important for the MINIMUM callout to be made by the auto-callout built-in system.

PF DUTY	PNF DUTY
1. Must also monitor the auto-callouts.	1. Must monitor the auto-callouts. The auto callout must commence by 400ft. RA, if not, call out : < NO AUTO-CALLOUT >.
2.CAT II approach is permitted with-out the Auto-callout function.	2. In case of no auto callout, callout: " HUNDRED ABOVE . & MINIMUM ", as applicable

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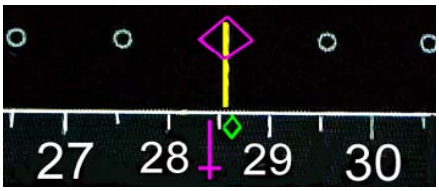
LAND MODE

As the a/c progresses down the ILS beam below 400 ft., **but** latest by 350 ft. the LAND mode must engage as shown. **Engagement of this mode is absolutely mandatory for CAT II & III operations.** Ψ*

The LAND GREEN Mode ensures that the LOC & GS modes are locked, at least one Radio Altimeter is available (CAT II) and that no FCU action can disengage the LAND mode at this important phase of flight progress. Only a TOGA action can change this mode.
Further, the LAND mode ensures that the FLARE, IDLE & ROLLOUT modes would normally also engage in its due course. If the LAND MODE is lost due any reason, a triple click is generated.

If no LAND MODE by 350 ft., accomplish a GO-AR.



Ψ* Refer page 66 for more information about the importance of this mode.

PF DUTY

(i) **Announce** " LAND GREEN ".
PF should confirm engagement of this LAND mode **and check the ILS course** indication on PFD is correct** as shown by the magenta dagger on the PFD's Hdg. Scale.

(ii) Now onward, PF to commence looking outside & inside.

(iii) If NO LAND MODE : Accomplice GO-AR, as this mode engagement is **mandatory** for CAT II & III operations.

PNF DUTY

Ψ* **A**nnounce " LAND GREEN " **as and when** it appears on your side

If NO LAND green by 350 ft. callout " NO LAND MODE ".

** In case of CAT II, if the ILS course is incorrect, as it may happen due to some FMGC problem continue approach and disengage A/P at 50 ft. latest if visual and comfortable to perform a manual landing since the **ALIGN** function may not be available after flare for a proper aligned touchdown, otherwise accomplice a GO-AR.

AT ' HUNDRED ABOVE' CALLOUT

This would appear at 195 ft. RA (VIDP). If not, the PNF would supplement this function, in case of a CAT II operation

PF DUTY	PNF DUTY
PF entry into decision zone	
Now, the PF must commence to only look out for establishing visual contact with the required visual reference a few seconds before the MINIMUM callout, and be ready to announce < LANDING > or < GO-AR FLAPS > at the MINIMUM callout, as the case be.	At this stage, now the PF is only looking out. Hence the inside / cockpit instrument monitoring responsibility lies solely on the PNF.

AT ' MINIMUM' CALLOUT

The PF must announce < LANDING > if the visual reference required has been established. Otherwise the PF must announce < GO-AROUND FLAPS >.	
Subsequently, right up to the touchdown, the PF must be able to maintain a visual contact with the required visual reference.	
If PF loses visual contact with the required reference, the PF must immediately announce < GO-AR FLAPS > and execute a GO-AR.	The PNF must always remain ready to select GO-AR flaps & subsequent actions, as required.

NOTE :
According to the Airbus Industrie, after having announced " LANDING", it is believed as not a good idea to perform a GO-AR for a temporary reduction of required visual references when an automatic landing & rollout is to be accomplished. This aspect be left at pilot discretion or as per the company procedure.(refer page 37)

FLARE MODE

The Flare-Mode engages once the Aircraft is between 50 ft RA to 40 ft. RA but latest by 30 ft. The precise value of this is a function of V/S. Upon engagement of this mode the FMA would appear as shown, thereby causing simultaneous actions as follows :

(i) At RA 30', the ALIGN ** mode / function also known as DECRAB sets-in, i.e. the auto-pilot aligns the aircraft yaw / fore-and-aft axis with the ILS LOC course i.e. runway centre-line, as the a/c may have been having a crab angle due to the cross-wind component correction.

(ii) A Flare / check / pitch round-off action is initiated here.

(iii) Engine power / thrust reduction to IDLE is then accomplished here and the FMA appears as shown

At RETARD callout, PF brings back the thrust levers to idle, upon this achievement, the FMA 1st Column would blank-off and the A/THR indication in 5th Col. would also disappear. Thereafter the Auto-Land would take place.

PROLONGED FLARE: There could be several reasons for the a/c to enter into a situation of an **extended flare segment** where the a/c would be touching-down beyond the touchdown zone i.e. beyond the TDZ barrettes due reasons such as high flare, strong/gusty wind, higher speed etc. Hence the pilot must execute a GO-AR as the a/c may not be able to stop within the remaining landing surface. A delayed GO-AR action may cause the wheels to touch the r/w but the GO-AR will be safely accomplished.

** **ALIGN SUB-MODE :** Align is a sub-mode of LAND that aligns the aircraft's axis with the ILS course. It is not displayed to the crew.

Note : Example the a/c is approaching VIDP28 with a cross-wind component from the right, i.e. the a/c hdg. is offset to 290^0. As the flare mode engages, the **ALIGN** mode's capability will now gradually commence to yaw the a/c only through the yaw axis towards the R/w direction / ILS course of 284^0 (by maintaining wings level).

If the wind is too strong i.e. from the right side the a/c may touchdown slightly to the left of the r/w center-line but will soon correct herself back to the center-line, this is why the max. crosswind component limitation of 20 kts. is established. Pilot must understand and anticipate this built-in yaw / **align** feature of the auto-land system.

…… Contd. Flare Mode

PF DUTY	PNF DUTY
	To call-out FLARE.
PF will observe the aircraft perform the Flare, engine power reduce to IDLE and the aircraft align with the runway. PF will retard the thrust levers to IDLE at the retard callout	Ensure the FMA 1st col. show IDLE. Check engine power reduces to Idle & 5th col. Blanks-off as the PF retards the T/L to IDLE.

IF NO FLARE MODE

. .	To call-out " NO FLARE " if the flare mode does not engage latest by 30 ft. RA

In case of CAT II, the PF must immediately disconnect the autopilot and perform a manual landing or accomplish a GO-AR, as the case be.

ROLLOUT MODE

The rollout mode engages after touchdown. Upon engagement of this mode the FD bars is replaced by the YAW-BAR which will guide the a/c on the r/w centreline using rudder, NWS and auto-brakes inputs from its associated BSCU if auto-pilot remains engaged. Selection of Reverse thrust and verification of deployment of ground spoilers must be done by the pilots. If the Auto-brake was armed, the PNF must callout DECEL along with Ground Spoilers & REV green.

If the auto-brakes have failed or no DECEL green the pilot must use brakes manually but let the auto-pilot remain engaged, if auto-land was performed.

NOTE **:** DECEL green lights may not appear immediately at touchdown on wet or contaminated runways when the deceleration rate associated with the selected mode has not achieved. Manual braking will not bring anything more hence allow the wheel spin-up to take place which would normally take place within a few seconds and thereafter the DECEL would appear. If it does not appear at all only then use manual brakes.

PF DUTY	PNF DUTY
	At touchdown ensure the engagement of the mode & callout < ROLLOUT >. Subsequently, " Ground spoilers, Reverse green, Decel" or as the case be.
PF to realize the engagement of this mode and can expect guidance & control function of the [AA/LS].	
Select Rev. Thrust <u>after</u> nose wheel contact with r/w.	

IF NO ROLLOUT MODE

During the Rollout phase if the ROLLOUT mode is lost, the pilot will have to take-over the directional control of the aircraft and bring the a/c to a complete halt using external reference. Yaw bar can be used in case of unexpected RVR reduction.
It has been determined by the Airbus Industrie that with an RVR 75 mts., the pilot has still enough external cues for the roll-out in case of AP disconnection.
The objective should remain to allow the A/Pilot and the Auto-Brakes to bring the a/c to taxi speed **ASAP** so as to minimize the time & distance of the Rollout segment thereby reducing chances of Fog Patch encounter and its associated problems.

PF DUTY	PNF DUTY
	Callout " NO-ROLLOUT MODE " if no engagement of this mode.
PF to understand that the ROLLOUT function is not available and will have to manually accomplish the directional control of the Aircraft.	
	If no DECEL GREEN, callout < NO DECEL GREEN >
The PF to bear in mind the above note i.e wait for a short while and thereafter decide the use of manual brakes.	
Allow Auto-Brakes to bring the a/c below 30 kts. before disconnecting the A/P or the Auto-brakes.	If no SPOILERs deployment, callout " Ground Spoilers NOT DEPLOYED "
	Callout speed below 70 kts., 30.

SECTION IV

APPEARANCES

APPEARANCES

In this section, the appearance of the Precision Approach Lighting System (**PALS**) is shown for various DHs with respect to RVR as applicable to CAT II & III operations

1. The first illustration is the appearance of the PALS plan view. Along with is a view of the PALS when on a 3^{o} G/S at about 1nm. to touchdown.
The PALS displayed is in regard to the CALVERT system, as installed at Delhi airport. For detailed information, refer to ICAO Annex. as shown in APPENDIX I.

2.The subsequent illustrations are for the CAT II & III approaches.

The various illustrations comprises of :
(i) The shadowed area which is OBSCURED due to the CUT-OFF ANGLE beneath the aircraft, as explained in aircraft optics. This is the area which would NOT be visible to the pilot at the respective DH.

(ii) The shadowed area which is OBSCURED due to the limited MINIMUM RVR, as explained in aircraft optics. This also, is the area that would NOT be visible to the pilot at the respective DH.

(iii) The clearly Visible area, as shown by the bracket for VISIBLE SEGMENT, is the area that would be visible to the pilot at the respective DH.

NOTE : Within the shadowed areas, the presence of the various associated lights have been shown in a dimmed manner so as to be of informative purpose only for the pilot as these would actually NOT be visible, but shown to enable pilot understand & imagine self orientation / i.e related position in regard to the portion of valuable lighting system.

For details regarding the geometrical & trignometrical calculations, reference be made to the respective APPENDIX from pages 70 to 75.

SECTION V

AIRCRAFT SYSTEM FAILURES

There are various types of aircraft ' Technical Systems ' which are integrated along with the [AA/LS] in order to perform CAT II & III automatic landing operations.

1.Most of the concerned technical DUAL systems are such as, dual ELACs, dual FACs, dual APs (4 channels), dual FWCs, etc. etc.
TRIPLE technical systems are also incorporated in the [AA/LS] such as, 3 ADRs & 3 IRs.

2. Some SINGLE aircraft technical systems / functions are also involved in the CAT II/III operations which may or may not be integrated to the aircraft's [AA/LS] but its availability for the conduct of CAT II / III operations is mandatory, such as, the ST.BY. HORIZON, windshield-wipers, etc. etc. as mentioned in the FCOM / AFM.

For CAT II / III operations, proper function of the various associated aircraft technical systems is necessary. The non-availability / malfunction of any such requisite system would degrade the capability of the auto-land system. The extent to what amount the degradation would occur will be determined by the nature & role of the failed system. A list of such technical system is mentioned in the FCOM / AFM.

A brief idea of the failures and their repercussion on the CAT II operations is made which would be elaborated in the next edition of this brochure.

GO-AR if FAILURES BELOW 1000 ft.(AGL) upto DH

A GO-AR will have to be accomplished in case of a failure of any of the significant system / function occurs prior to DH.
A GO-AR is suggested so as to enable the pilot to join the hold & comfortably make a reassessment of the situation, take appropriate actions and decide accordingly.

Some of the conditions listed where a CAT II approach has to be discontinued are :
1. Alpha-floor activation. (up to 100 ft.)
2. Auto-pilot failure. (as the case be, 1 AP is reqd. for CAT II)
3. Loss of CAT 2 indication on FMA. i.e. capability degraded to CAT I
4. Any significant amber caution.
5. Check Attitude warning.
6. Engine failure.
7. Wind-screen wiper failure for the PF, at pilot discretion.
8. Window Heat failure for the PF, at pilot discretion.
9. No LAND (green) function available on FMA.
10.Auto-Land RED flashing light.*
11.Any other such failures, as listed in the FCOM /AFM.

* The RED auto land light can only trigger below 200 ft. If it occurs below DH execute a GO-AR immediately. In case of CAT II, if it triggers below DH, when the VRR is established, if the pilot feels confident the AP must be disconnected and a manual landing accomplished.

FAILURES NOT AFFECTING CAT II OPERATIONS

The conduct of CAT II operations can be CONTINUED in case of the following failures / non-availability :

1. A/THR failure / THR LK. (Pilot can use manual thrust)
2. TLA fault / TLA Disagree.
3. BSCU fault. / Auto brake fault. (Pilot to use manual brakes)
4 A/Skid fault Disconnect A/P at touchdown.(---- do ----)
5. NWS fault (--- do ---)
6. Auto-call out function loss (PNF to give call-outs as reqd., in case of CAT II only)
7. Engine FIRE. (refer to Engine FIRE para)
8. Incorrect Selected ILS course : continue approach and disconnect the AP at 50 ft. latest, as the align feature may not be available

FAILURES BELOW 100 ft.:

The aircraft's auto-land capability would be frozen when the aircraft is below 100 ft. RA if the FMA was displaying CAT 3 DUAL.
In regard to CAT II operations, except for very significant failures, the performance capability would not normally be degraded i.e. in most of the cases a GO-AR would not be required but it would always remain a decision for the pilot to judge & decide irrespective of system display / availability.

FD FAILURE :
The FD is not a mandatory requirement for CAT II operations and its failure would not degrade the capability of the ALS but the YAW-BAR is an integral function of the FD which would also not be available.
This yaw-bar function loss could however be made up / compensated by the use of the LOC index (diamond) on the PFD and the LOC bar on the ND for directional guidance.

CHECK ATTITUDE WARNING :
If this message appears at any stage of the approach, immediately accomplish a GO-AR. The PF MUST immediately disconnect the auto-pilot and execute a GO-AR with reference to the STBY HOR. since at this stage, it is not certain as to which, the PF or the PNF side ADI is faulty. After reaching a safe altitude, an assessment could be made as to which ADI has malfunctioned by comparing the three.
For CAT II operations the availability of all three ADIs is mandatory. Accomplish an ADR transfer to regain the failed ADI and again attempt a CAT II approach. If unable, a CAT II operation cannot be accomplished. Switching only to be attempted when aircraft height above 1000 ft.

FAILURE OF LOC or G/S TRANSMITTER:

1. Corresponding index is lost.
2. LOC & GS scales flash.
3. Corresponding FD bar flashes.(i.e. FD vertical bar will flash in case of a LOC failure)

If the failure is of a transient / temporary nature,(for about 1-2 secs) the FMA would retain the LOC & G/S modes and the auto-land system could regain the capture of the LOC & G/S but if the duration of failure is for a longer period, a GO-AR would have to be accomplished.

Loss of LOC signal when > 15' or G/S signal when > 100 would cause FD bars to flash for 10 Secs. but LAND mode will remain engaged.

► In case of LOC or G/S Receiver failure, a corresponding red flag would be displayed.

FALSE GLIDE SLOPE :

A HEIGHT CHECK over LOM is very important to ensure correct G/S interception altitude. Thereafter just before crossing the threshold, the pilot must be able to identify the GREEN threshold bar to positively confirm correct a/c position. The presence of a highway vehicular traffic in close proximity of a runway could subject this type of a hazard due to unscreened / improper high-tension automobile ignition system etc.

If any doubt, accomplish a GO-AR.

ENGINE FIRE (ENGINE FIRE at 1000 ft. upto DH) :

Whenever you get a fire warning bear in mind that the aircraft and its occupants are subjected to a grave endanger. Announce Mayday / PAN PAN,, as the case be.

If you have an engine fire on approach there are two aspects **:** ↔ whether to continue and land **or** whether to Go-AR ?

l. You may have a genuine engine fire which could be indicated by other engine parameters & or accompanied with burning smell etc OR it may be a false warning / indication problem only.

2. If it is possible to identify and take suitable actions it would be very wise to continue the approach and go land ahead, **but** if your attention gets diverted too much from your primary duties of approach - monitoring, important Call-outs & associated crew task sharing or if the a/c gets out of trim / control where a safe landing becomes impossible **only then, as a last resort,** a GO-AR would be appropriate where you would be required to accomplish the fire drill and land back ASAP.

3. Bear in mind that whenever you Go-AR due to a genuine engine fire you may further seriously aggravate the engine fire resulting into serious consequences. Subsequently you may or may not be able to control the engine fire but yet you will not be able to accomplice a relight AND you will in all cases have to land back ASAP. Hence the more sensible action would be to continue the approach, go and land and thereafter carry out the fire drill / actions after landing. Many airlines' SOPs have left this aspect at pilot discretion.

ACTION :

If an engine fire warning appears below 1000 ft., retard the fire affected engine Thrust Lever to IDLE, and time permitting accomplish the ECAM actions & inform the ATC.

If the fire warning has appeared close to the DH, it would be wise to just continue the approach and land. At this critical stage do not divert the attention form the primary objective of sighting the visual reference required. But if a/c flight path gets de-stabilized and uncontrollable, then GO-AR.

ENGINE FAILURE :
If an engine failure occurs below DH, just continue & land.
If the failure occurs well above the DH, a GO-AR is recommended to ensure that there is no chance for significant out-of trim conditions for a longer time in which case it is better to Go-around, complete the procedures for engine failure and then land back.(you may also get back a flamed-out engine)

ANTI-SKID OR NWS FAILURE :
CAT II approach can be continued with this failure but disconnect the AP at touchdown.
If this failure occurs during the rollout phase, disconnect the AP.

FALSE G/S or LOC :
Pilot must be able to **SEE & IDENTIFY** the correct portion of the PALS / Lighting in regard to the respective DH **and also subsequently** thereafter before allowing the a/c to continue any further below for landing, as mentioned in page 34/35.

LAND GREEN and its co-relation with Radio Altitude indication veracity.
Land Green would appear on each side at a RA so triggered by the on side FMGC, if both RA indications are matched i.e. within close tolerance, Land Green would appear on both side FMAs almost together but if there is a difference in the two RAs then Land Green would appear a little later for the side where the RA is indicating a higher value. i.e. if the Master FMGC has decided to trigger Land Green at 360 ft. RA, the side where the RA indication arrives at 360 ft. first will have Land Green displayed first, if both side RA indications arrive at 360 ft. together, then Land Green would appear on both side together.
Appearance of LAND GREEN on the FMA must be immediately announced by the pilot whosoever gets it first as this will give an indication as to whether there exists any difference between the two Radio Altimeters i.e. if PF calls out LAND GREEN, the PNF should also call out Land Green simultaneously if it also appears together an his/her side FMA and this would confirm matched synchronization of both RAs but if the PNF side LAND GREEN appears a little later, the PNF should call out LAND GREEN as & when it appears. Similarly if the PNF gets it first the PF should callout Land GREEN as and when it appears on his /her side FMA so as to ascertain the difference in time/height.
If PF's RA indication is lower than the true /correct (absolute) height above ground this would result in an earlier / high FLARE, so be careful about this aspect as this could result in to a prolonged flare situation and its complications. (Auto Flare for landing is performed by [AA/LS] based on RA.)

AUTO-LAND PRACTICE TIPS

1. Do not modify / increase the Vapp. in MCDU.
Enter the reported wind as usual, if the Vapp is increased, there may be a chance of ballooning tendency during the flare /touchdown stage because the auto-land system induces a pre-set calibrated amount of input to the elevators for the flare/ round-off action. This feature of the system takes into account the existing V/S, speed, AUW etc. and in most cases, ensures a smooth / comfortable touchdown.

2. In case the [AA/LS] performs a high flare due whatsoever reason, there exists a very high probability for the aircraft to float excessively and then for the aircraft to acquire a more tail-down attitude at touchdown with a likelihood of a tail-strike. In such a case immediately disconnect the AP or perform a GO-AR , as appropriate.
At about 11^{o} pitch attitude, the rear fuselage can make contact with the ground.

3. Do not practice auto-lands at airports prone to be causing undesirable performance in regard to CAT II approach & landing operations. Inform the ATC whenever an Auto-Land is to be performed so that proper control over the sensitive / critical area is accomplished as that would effect the quality of the ILS beams thereby affecting the best touchdown.

WIND LIMITATIONS FOR CATII/III AUTO APPROACH, LANDING & ROLL-OUT **:**

HWC = Max. 30 Kts. ; TWC = Max. 10 Kts. ; Max. CROSS-WIND COMP. = 20 Kts.

AUTO-LAND DURING GUSTY / TURBULENT CONDITIONS :

OEB No. 146/3

For approach to runways with known gusty environments, specially if conditions generate vertical gusts due surrounding terrain OR
When the reported wind gust increment is >10 kts. OR
When moderate to severe turbulence is expected on short final **:**

- Use Conf Full or 3 for automatic approach & landing
- Minimum VAPP is VLS+5; use managed speed.
- Strictly apply automatic approach and landing procedures even with visual references been established
- If auto approach & landing is discontinued, immediately initiate a Go-AR, manual landing is **not authorized**

Note: Down draft or gusty conditions close to the ground may lead to a hard touchdown. A GO-AR initiated close to the r/w in down-draft or gusty conditions may lead the a/c to contact the r/w. Continue the go-around normally i.e. DO NOT dis- engage the Auto-Pilot.

FCOM 3.01.22/ p3 :

ENGINE OUT :

CAT II & III fail passive auto-land are only approved in Conf FULL, and if engine-out procedures are completed before reaching 1000 feet in approach.

CAT 2 OPS. CHECKLIST

CHECKS AT DESPATCH

1. Confirm ILS CAT II / III facility at destination is available.
2. Check alternate weather and availability of approach facility.
3. Consider extra fuel requirement.
4. Check NOTAMS for any significant aspect.
5. Check status of aircraft.
6. Check for crew qualification / recency.

BEFORE LVTO

1. Check minimum 3 segments of runway lighting system is visible.
2. Have ILS pb. ON with ILS selected on RAD.NAV page.
3. Brief PNF regarding of Transfer of Vision, as in page 35.
4. Adjust Seat suitably. Have / let heels remain on floor.

IN CRUISE DISCUSSIONS :

1. Check aircraft status.
2. Check dest./alternate weather & FOB.
3. Check Minima.
4. Check & discuss the IAL charted procedure.
5. Check with ATC – availability of CAT II.
6. Check Crew qualification.
7. Review & discuss Approach Ban.
8. Check & Review Task sharing.
9. Review of Technical Malfunction proc.
10. Glance of the Appearance of VRA.
11. Discuss about cockpit & external Lighting.
12. Cabin-Crew briefing.
13. Review to Lock cockpit door.
14. Brief PNF regarding of Transfer of Vision, as in page 35.

GO-AR if SYSTEM FAILURES BELOW 1000 ft. UPTO DH :

1. Alpha Floor.
2. Autopilot failure.
3. Loss of CAT 2 indication on FMA.
4. Any significant amber caution.
5. Check Attitude warning.
6. Engine failure.
7. Wind-screen wiper failure for the PF. (at pilot discretion)

8. Window Heat failure for the PF (--- do ---)
9. No LAND (green) function available on FMA.
10. Auto-Land RED flashing light.
11. Any other such failures, as listed in the FCOM /AFM.

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FAILURES **NOT** AFFECTING **CAT II** OPS.

The conduct of CAT II operations can be **CONTINUED** in case of the following failures / non-availability **:**

1. A/THR failure / THR LK.
2. TLA fault / TLA Disagree.
3. BSCU fault./Auto brake fault. (Pilot to use manual brakes)
4. A/Skid fault.(Disconnect A/P at touchdown) (-- do --)
5. NWS fault. (--- do ----)
6. Auto-call out function loss (PNF to give call-outs).
7. Engine FIRE.
8. Incorrect Selected ILS course, Disconnect A/P at 50 ft.& **No** Auto Land .

APPROACH CHECKS (10,000 ft.)

1. IAL specified chart briefing only.
2. Check latest aircraft status.
3. Check with ATC if LVP activated.
4. Check Seat adjustment.(MOSP)
5. Select Auto-brakes.
6. Lock cockpit door.
7. Brief PNF regarding of Transfer of Vision, as in page 35.
8. PF to PNF =>

(i) " In case there is no response/acknowledgement from me to your two consecutive callouts, you can presume my subtle incapacitation. You will immediately confirm & initiate a GO-AR.

(ii) You will remain & maintain head-down to monitor the instruments during the entire approach, landing and to the end of the roll-out, and call-out :

1000 ft & 500 ft (AGL) …Baro Altitude
LAND GREEN (PF Callout)

FLARE OR NO-FLARE
ROLLOUT
GROUND SPOILERS, REVERSE GREEN, DECEL.

IF NO AUTO-CALLOUTS, YOU WILL CALLOUT HUNDRED ABOVE
&
MINIMUM ".

CAT 2 WISDOM

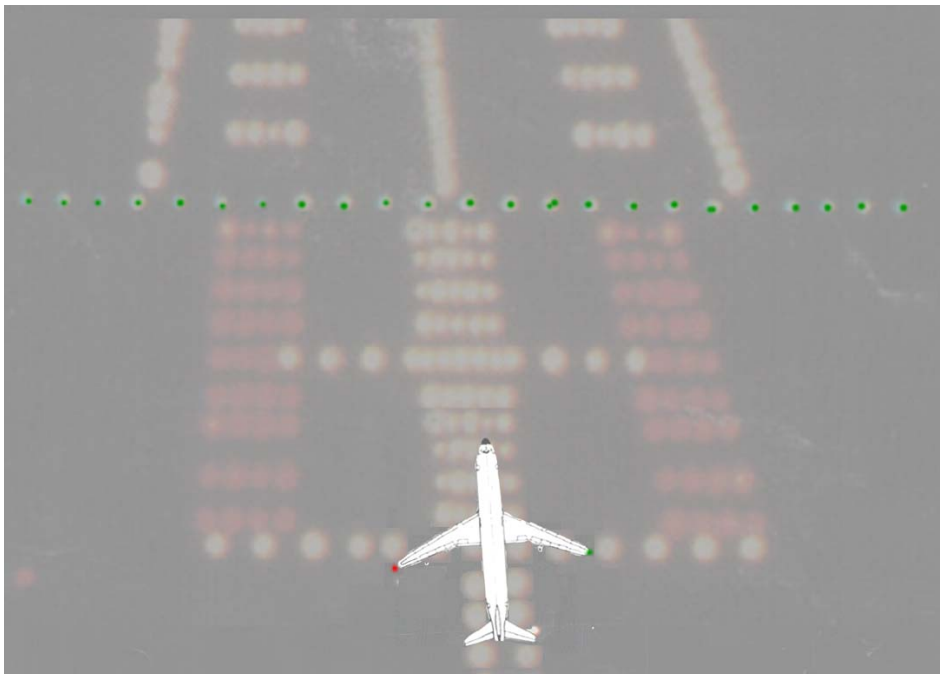
EDITION III

. . . . . closer to the reality of flying

The experts of the AIRBUS INDUSTRIE had examined the contents of this brochure (CAT 2 WISDOM Edition I). Comments made by them have been incorporated in this revised edition. A copy of their letter expressing their comments is attached at the end.

A - 320

CAT 2
W I S D O M



Enjoy getting Closer to the reality of flying

EDITION III
2003 (Jan.)

An APPENDIX arrangement from page 70 to 75 has been made to indicate more detailed explanations and calculations, as may be desired for confirmative understanding.

This brochure being an important guide for the efficient conduct of flight operations in civil aviation, it would not be righteous to hold the right of reproduction of this in any form. All concerned with aviation are at liberty to reprint and use it with a good spirit of professionalism.

All aspect of this brochure has been expressed in good faith. The author would not be responsible for any error in regard to any aspect of its contents but, if any, would be resolved in the next edition.

Capt. P.N.Sharma
B.E. (Aeronautics), MAeSi.
Executive pilot, Indian Airlines

Kindly send valuable suggestion and comments at :

E-mail: < nitins@del2.vsnl.net.in >

Tel No. 26144884
Fax : 26144884 with prior intimation, (thru PC).

Edition I ... 1999
Edition II ... 2002
Edition III ... 2003

CONTENTS

SECTION V

GLOSSARY OF ABBREVIATIONS

[AA/LS] : Automatic Approach / Landing System

ALS : Approach Lighting System

DH : Decision Height

IAL : Instrument Approach & Landing

LVP : Low Visibility Procedure

MABH : Minimum Approach Break-off Height

MOSP : Most Optimum Seating Position

PALS : Precision Approach Lighting System

RA : Radio Altitude

SVR : Slant Visual Range

VRA : Visual Reference Available

VRR : Visual Reference Required

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Capt. P.N. SHARMA
D-1/20 Indian Airlines Colony
Vasant Vihar
New Delhi 110 057
INDIA

Dear Captain,

You will find enclosed a copy of your brochure "CAT 2 WISDOM" you sent to us for comments.

We would like to mention that we found it very informative, and believe it is a comprehensive guide regarding the operational aspects of CAT II/CAT III.

On the attached copy you will find directly some comments for your consideration.

Do not hesitate to contact us if you need further information.

Truly Yours,

Guy DI SANTO
Dept Manager
Airlines Operations Support

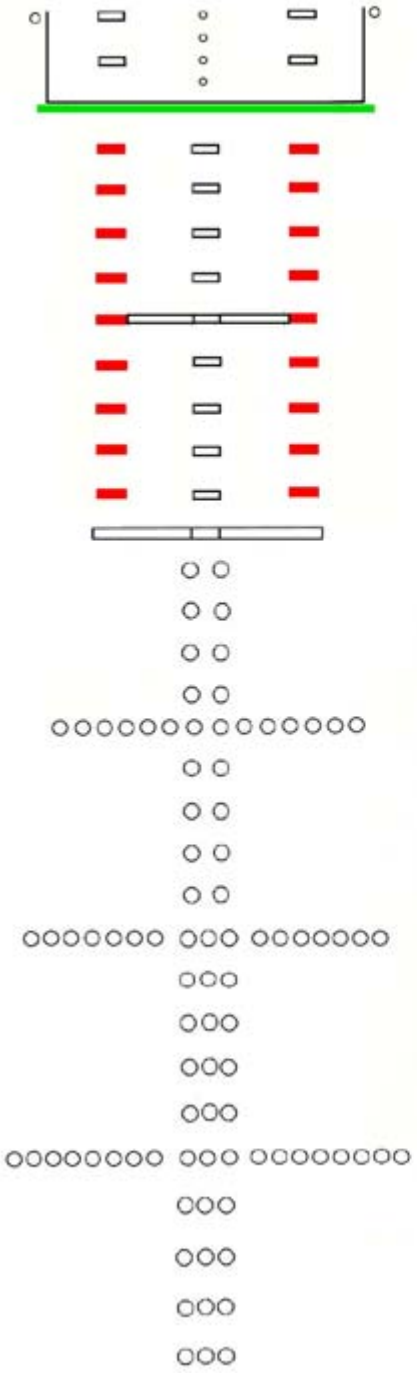
Michel BRANDT
Deputy Director
Flight Operations Support

GROUPEMENT D'INTERET
ECONOMIQUE REGI
PAR L'ORDONNANCE No 67821
DU 23 SEPTEMBRE 1967
R.C.S. TOULOUSE C 302609607

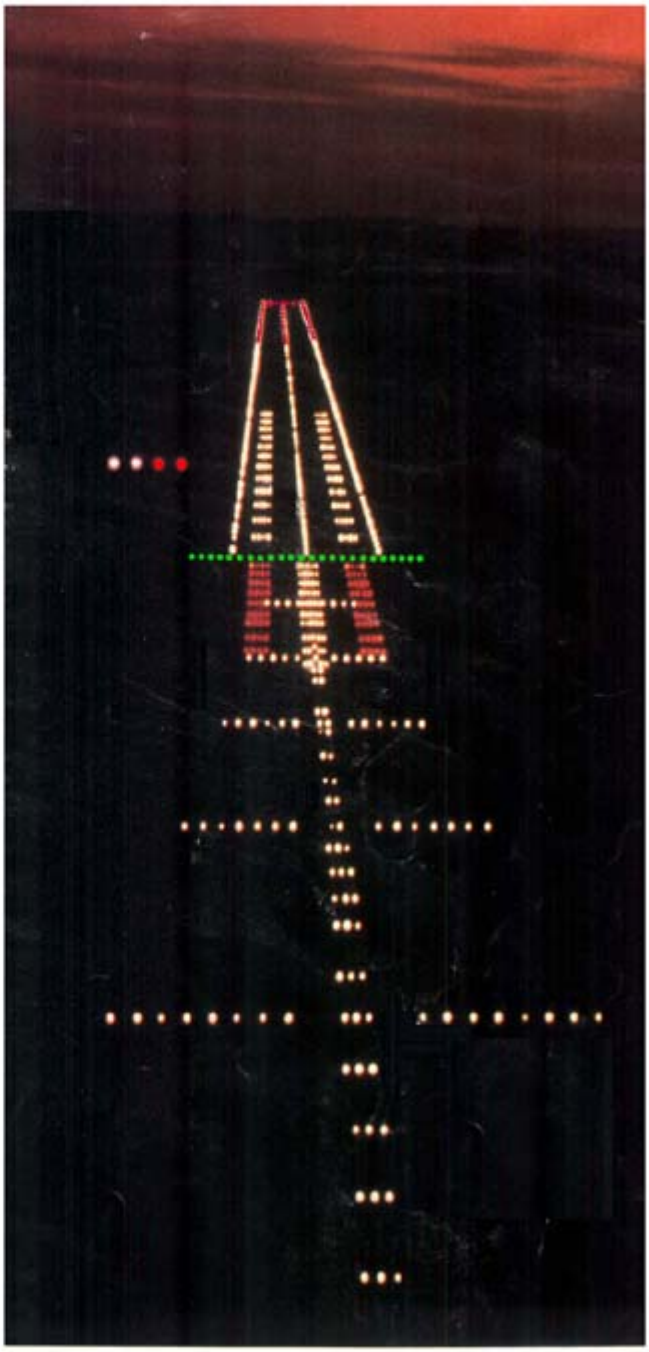
APPEARANCE OF THE PRECISION APPROACH LIGHTING SYSTEM (PALS)

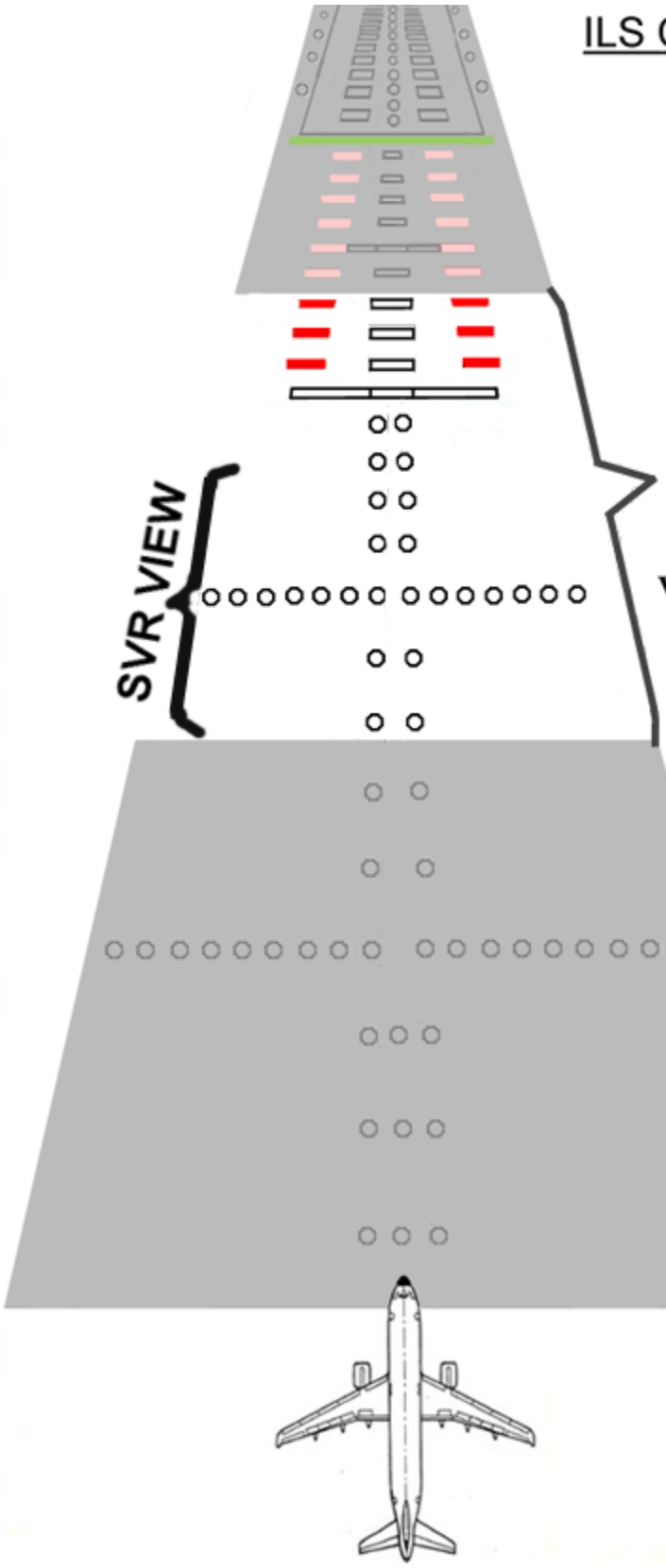
VIDP Rwy 28 (CAT II)

PLAN VIEW (ICAO)



NIGHT / TWILIGHT VIEW





ILS CAT II (INTERIM / RESTRICTED)

DH 150 ft. / RA 134 ft.(VIDP 28)

RVR 500 mts.

APPEARANCE OF THE "VISIBLE REFERENCE AVAILABLE" TO PILOT DURING THE ILS CAT II APPROACH AT DH.
(BASED ON STANDARD ICAO FORMAT OF BARRETTE / LIGHTING DISPLAY.)

VISIBLE SEGMENT

VISUAL REFERENCE AVAILABLE

I. RVR VIEW

11 LIGHT SEGMENTS WOULD BE VISIBLE TO PILOT AT DH. BASED ON MIN. RVR 500 mts., PILOT SEATING AT MOSP & AIRCRAFT PITCH = 4.7°

II. SVR VIEW

WHEN CONSIDERING THE SVR ASPECT, ONLY THE FIRST 4 / 7 LIGHT SEGMENTS WOULD BE VISIBLE TO PILOT AT DH DUE TO THE RVR / SVR RELATION DURING MATURED FOG.

VISUAL REFERENCE REQD.

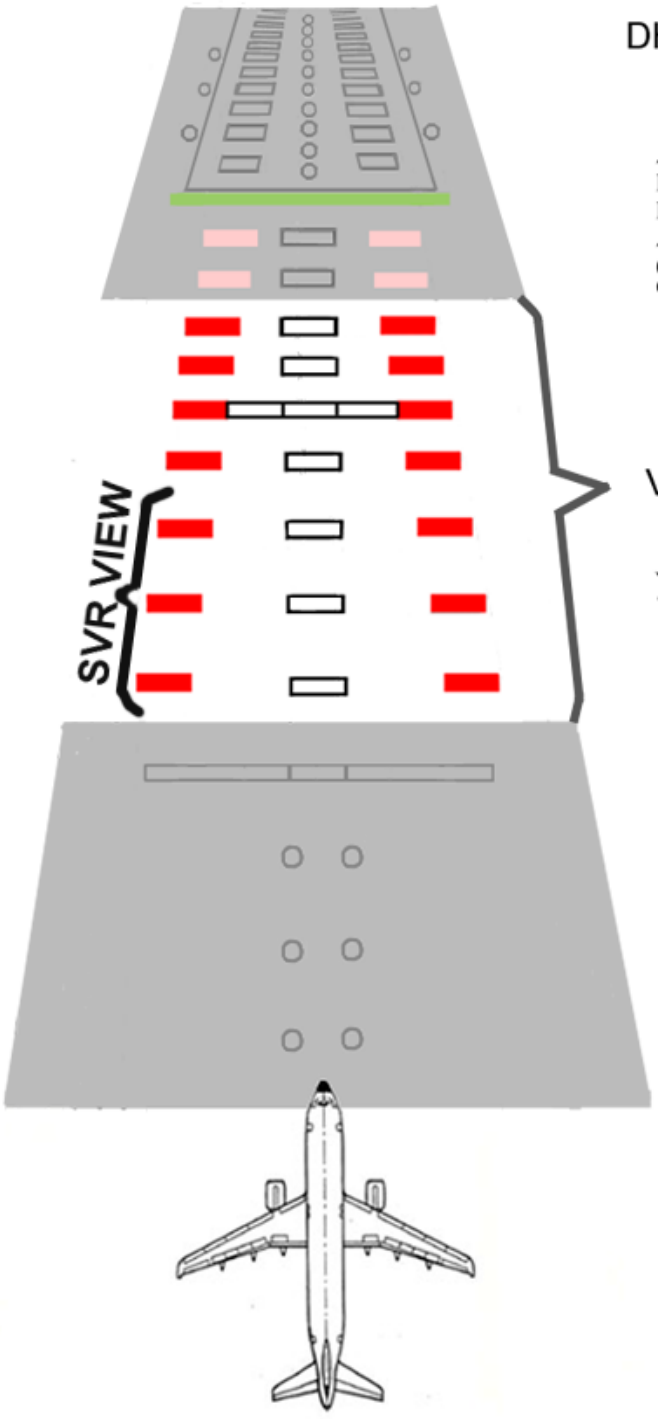
FOR A DECISION OF < LANDING > AT DH & THEREAFTER, AT LEAST 3 LIGHT SEGMENTS MUST BE VISIBLE UPTO THE TOUCHDOWN.

COMPLETE DETAILS OF THE APPROACH VIEW & CALCULATIONS OF THE VARIOUS DISTANCES CAN BE SEEN IN APPENDIX II

ILS CAT II

DH 100 ft. / RA **95** ft. (VIDP28)

RVR 350 mts.



APPEARANCE OF THE VISIBLE REFERENCE AVAILABLE TO PILOT DURING THE ILS CAT II APPROACH AT DH.
(BASED ON STANDARD ICAO FORMAT OF BARRETTE / LIGHTING DISPLAY.)

VISIBLE SEGMENT

VISUAL REFERENCE AVAILABLE

I. RVR VIEW

7 BARRETTES WOULD BE VISIBLE TO PILOT AT DH.
BASED ON MIN. RVR 350 mts. & PILOT SEATING AT MOSP, AIRCRAFT PITCH = 4.7°

II. SVR VIEW

WHEN CONSIDERING THE SVR ASPECT, ONLY THE FIRST 3 / 5 (BARRETTES)WOULD BE VISIBLE TO THE PILOT AT DH DUE TO THE RVR / SVR RELATION DURING MATURED FOG.

VISUAL REFERENCE REQD.

FOR A DECISION OF < LANDING > AT DH & THEREAFTER, AT LEAST 3 LIGHT SEGMENTS MUST BE VISIBLE UPTO THE TOUCHDOWN.

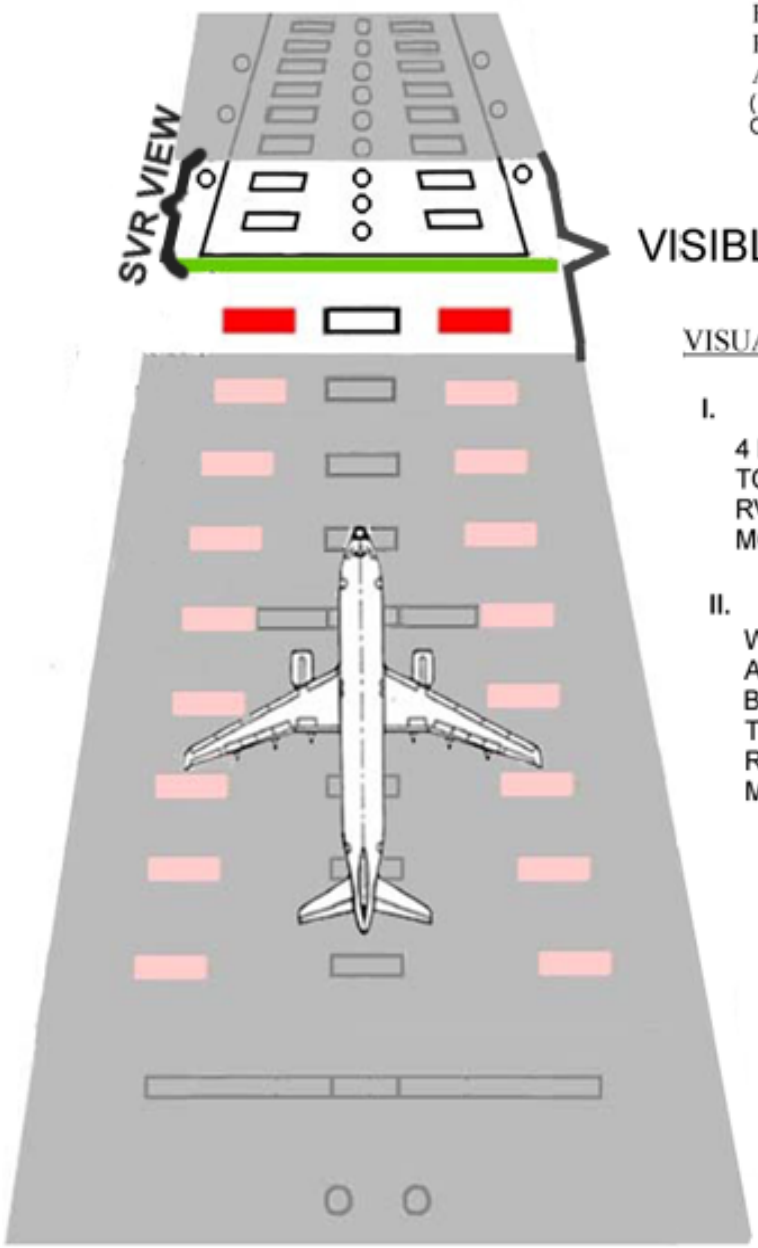
COMPLETE DETAILS OF THE APPROACH VIEW & CALCULATIONS OF THE VARIOUS DISTANCES CAN BE SEEN IN APPENDIX III.

ILS CAT III

DH 50 ft. (VIDP 28)

RVR 200 mts.

APPEARANCE OF THE VISIBLE REFERENCE AVAILABLE TO PILOT DURING THE ILS CAT III APPROACH AT DH.
(BASED ON STANDARD ICAO FORMAT OF BARRETTE / LIGHTING DISPLAY.)



VISUAL REFERENCE AVAILABLE

I. **RVR VIEW**

4 BARRETTES WOULD BE VISIBLE TO PILOT AT DH. BASED ON MIN. RVR 200 mts. & PILOT SEATING AT MOSP, AIRCRAFT PITCH = 4.7°

II. **SVR VIEW**

WHEN CONSIDERING THE SVR ASPECT ONLY THE FIRST 2 / 3 BARRETTES WOULD BE VISIBLE TO THE PILOT AT DH DUE TO THE RVR / SVR RELATION DURING MATURED FOG.

VISUAL REFERENCE REQD.

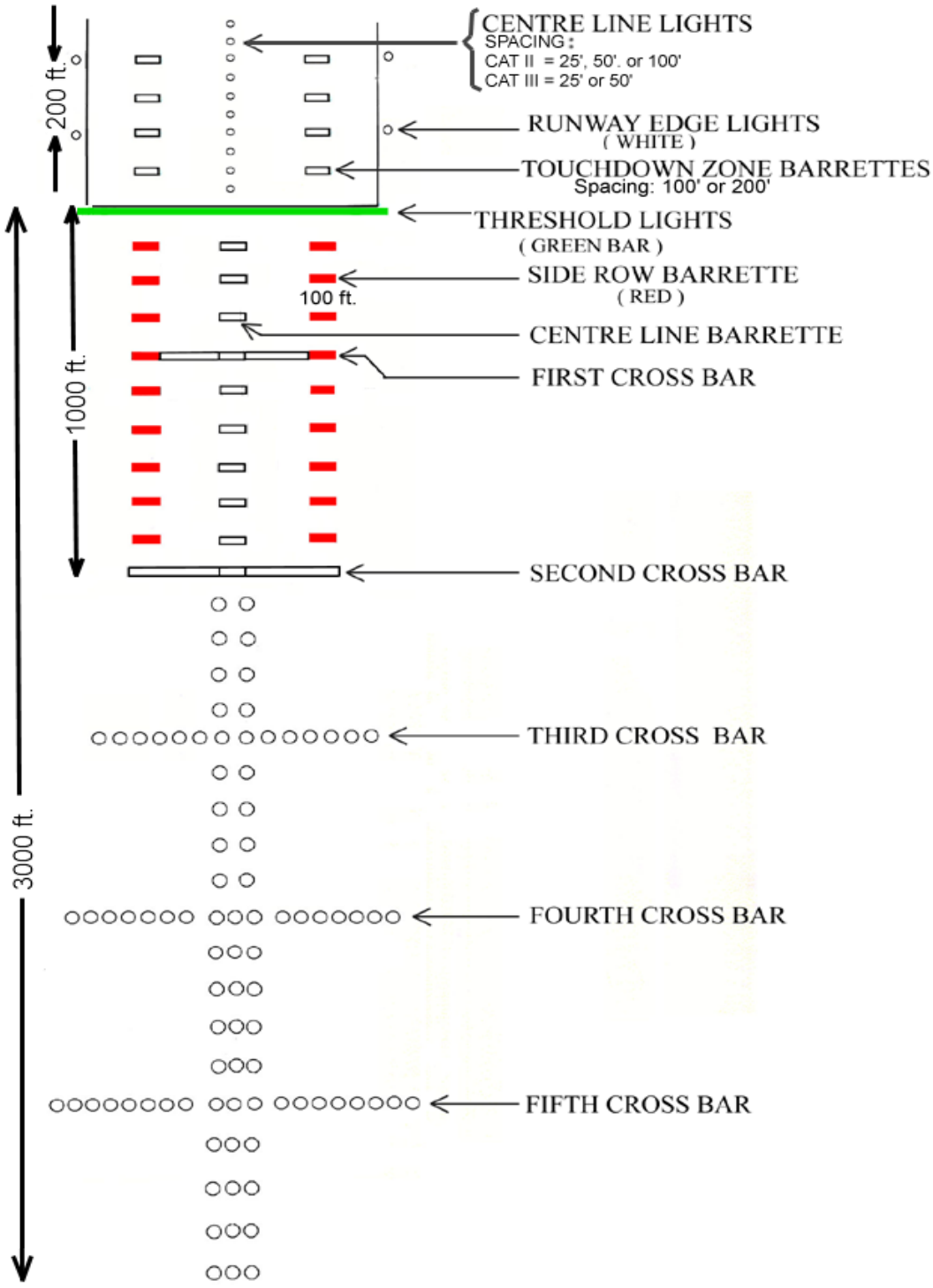
FOR A DECISION OF < LANDING > AT DH & THEREAFTER, AT LEAST 3 LIGHT SEGMENTS MUST BE VISIBLE UPTO THE TOUCHDOWN.
(for CAT III A)

COMPLETE DETAILS OF THE APPROACH VIEW & CALCULATIONS OF THE VARIOUS DISTANCES CAN BE SEEN IN APPENDIX IV.

APPENDIX I

APPEARANCE OF THE PRECISION APPROACH LIGHTING SYSTEM

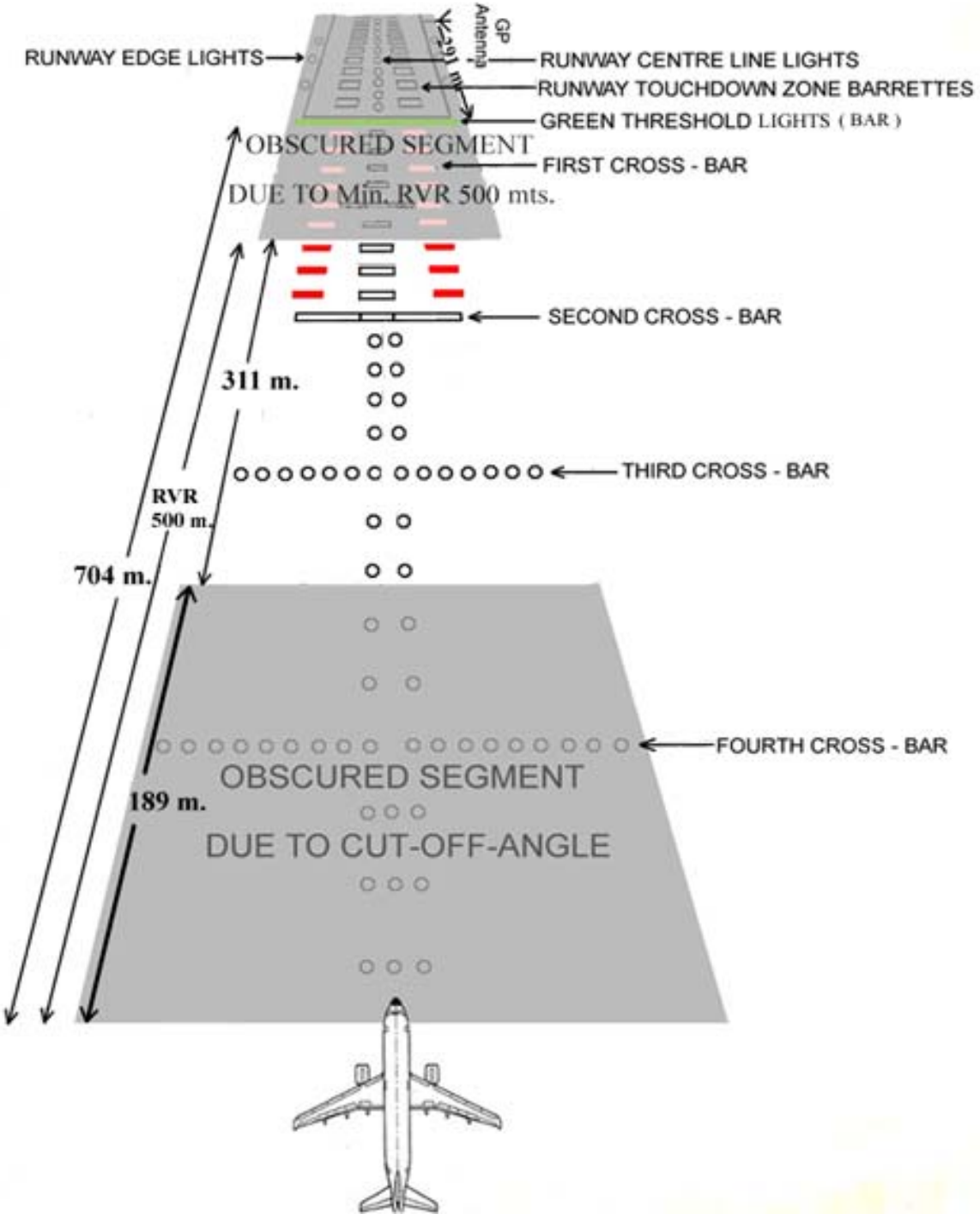
VIDP Rwy 28 - CAT II/III



APPENDIX II

ILS CAT II (INTERIM / RESTRICTED)

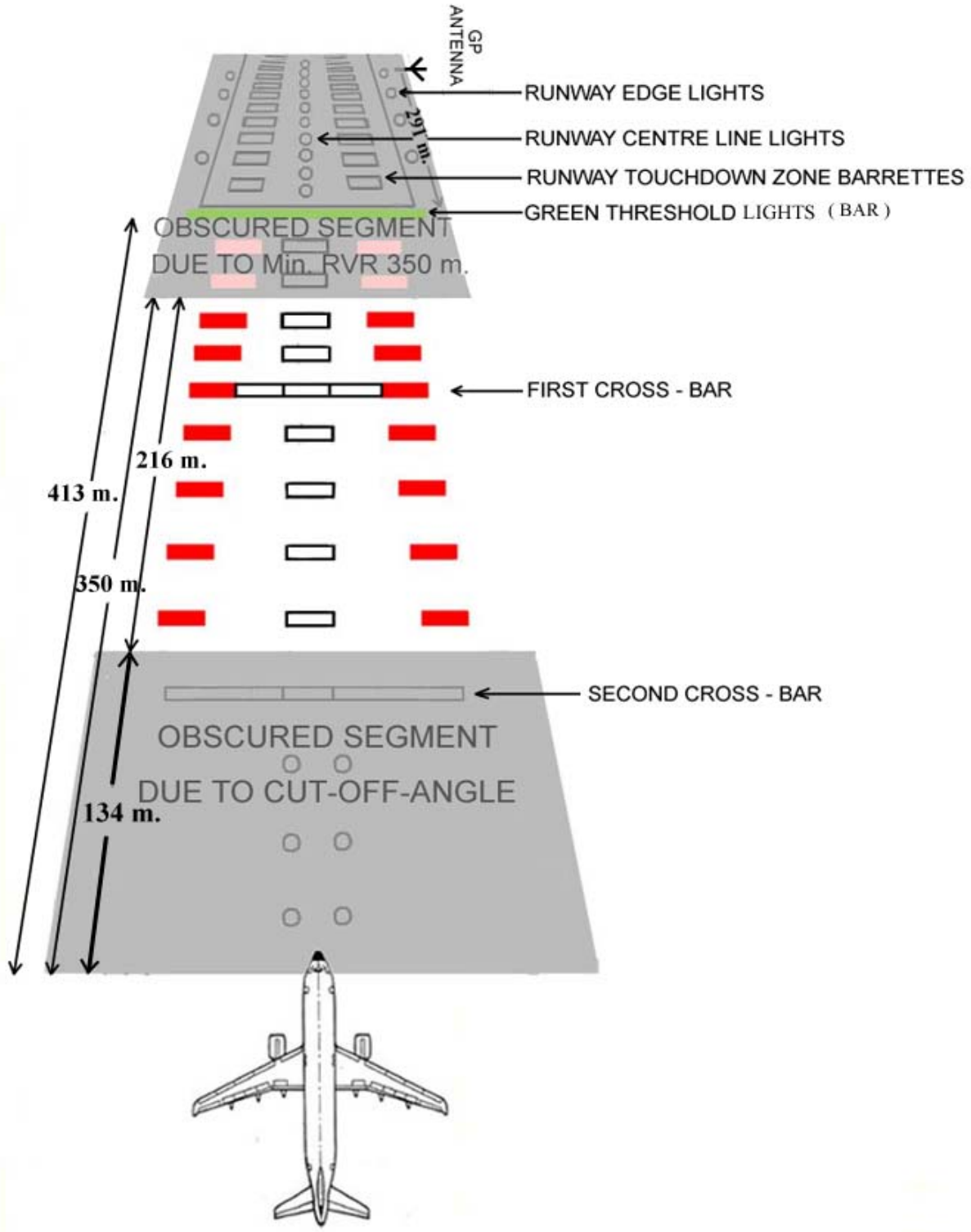
DH 150 ft. / RA 134 ft.(VIDP 28)
RVR 500 mts.



APPENDIX III

ILS CAT II

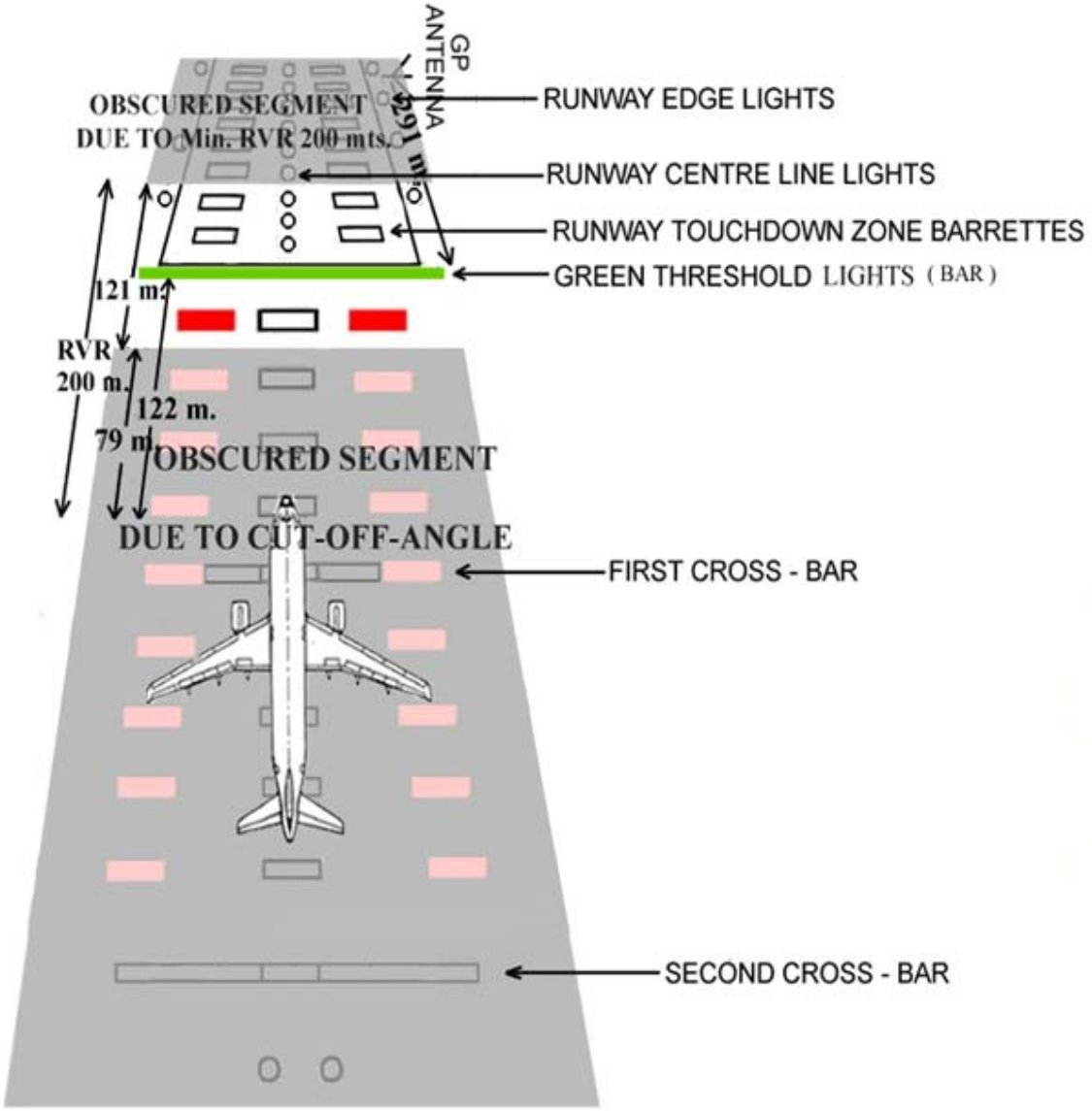
DH 100 ft. / RA **95** ft. (VIDP 28)
RVR 350 mts.



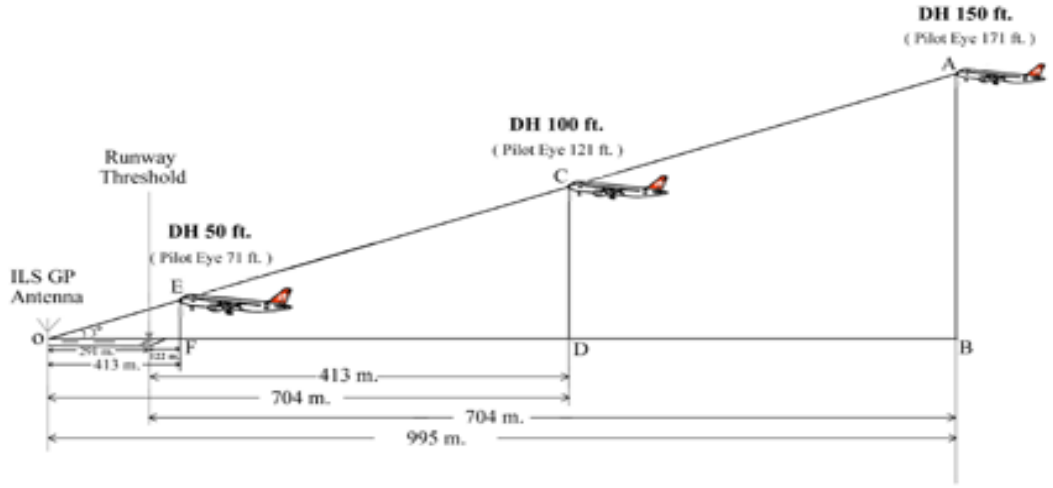
APPENDIX IV

ILS CAT III

DH 50 ft. (VIDP 28)
RVR 200 mts.



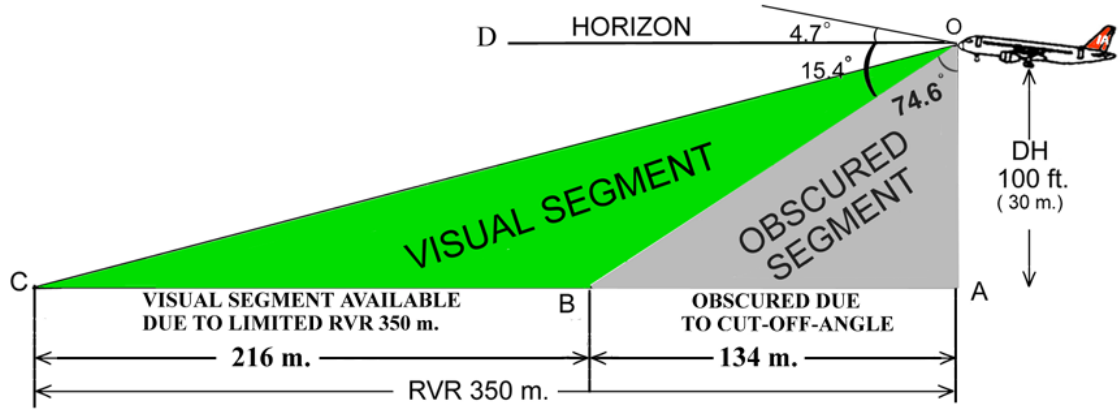
APPENDIX V



$$OF = \frac{71}{\text{Tan } 3^{\circ}} = \frac{71}{.0524077} = 1355 \text{ ft.} (413 \text{ m})$$

$$OD = \frac{121}{\text{Tan } 3^{\circ}} = \frac{121}{.0524077} = 2308 \text{ ft. } (704 \text{ m})$$

$$OB = \frac{171}{\text{Tan } 3^{\circ}} = \frac{171}{.0524077} = 3263 \text{ ft. } (995 \text{ m.})$$



The green visual segment is the useful area
of vision, pilot can see ground segment / distance B to C.

angle BOD = 15.4° = DOWN VISION ANGLE
OBSCURED SEGMENT = 74.6° = CUT-OFF-ANGLE

Data obtained from FCOM 3.03.22/p2, as in above fig.

The obscured segment is from A to B = 134 mts.

$Tan\theta = 37/134 = .2761$

$\theta = 15.4^{0}$

OA is the pilot height at DH = 37 mts. (121 ft.)

The angle OBA = 15.4^{o}

Angle BOD (available below the horizon) = 15.4^{o}

Thus the DOWN-VISION ANGLE = 15.4^{o}

The angle AOB = 180 – (90 + 15.4) = 74.6^{o}

Thus the CUT-OFF ANGLE = 74.6^{o}

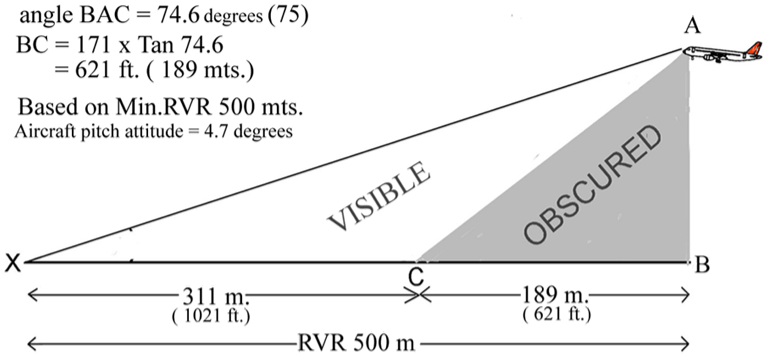
APPENDIX VI

.DERIVATION OF VISIBLE & OBSCURED SEGMENTS

DH 150 ft. /RA 134 ft. (Pilot Eye at 171 ft.)

angle BAC = 74.6 degrees (75)
BC = 171 x Tan 74.6
= 621 ft. (189 mts.)

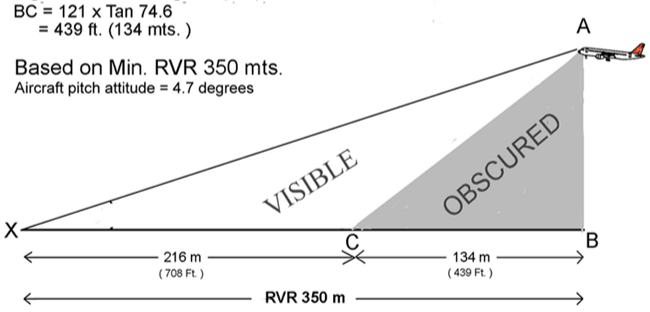
Based on Min.RVR 500 mts.
Aircraft pitch attitude = 4.7 degrees



DH 100 ft./ RA 95 ft. (Pilot Eye at 121 ft.)

angle BAC = 74.6 degrees (75)
BC = 121 x Tan 74.6
= 439 ft. (134 mts.)

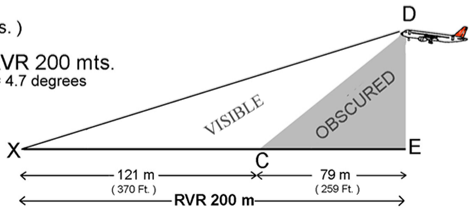
Based on Min. RVR 350 mts.
Aircraft pitch attitude = 4.7 degrees

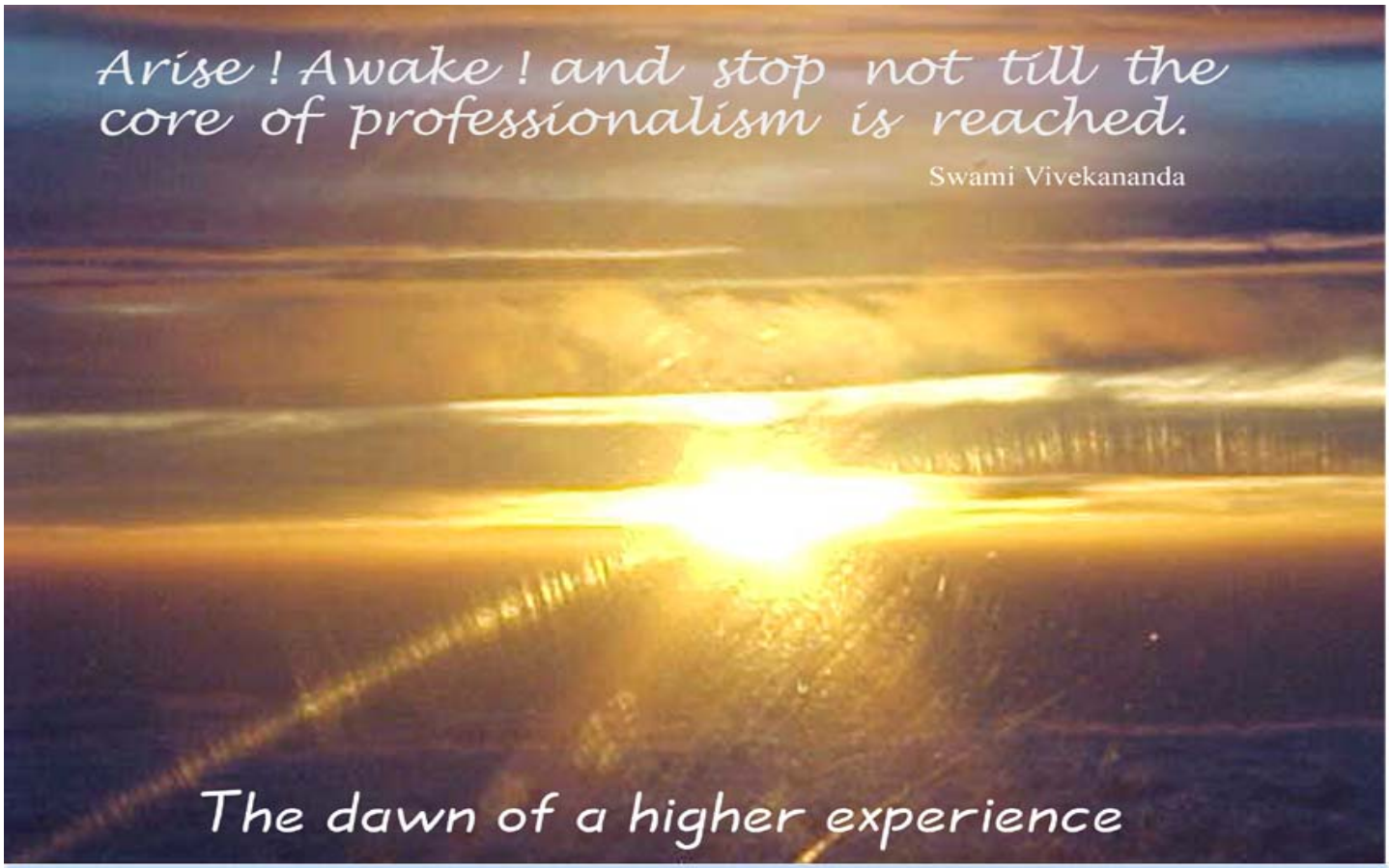


DH 50 ft. (Pilot eye at 71 ft.)

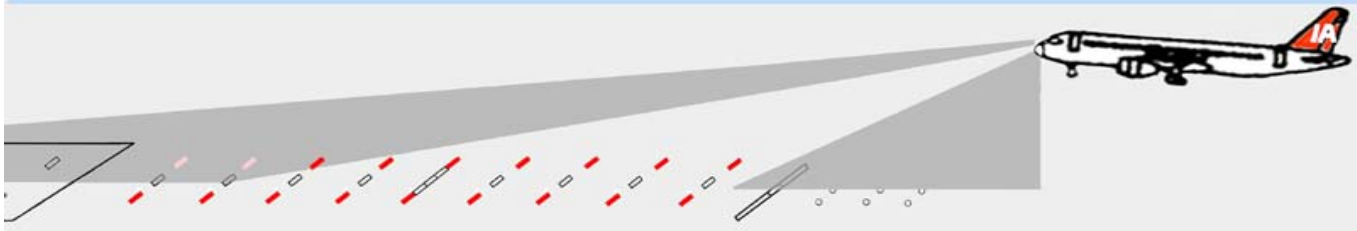
angle EDC = 74.6 degrees (75)
EC = 71 x tan 74.6
= 258 ft. (79 mts.)

Based on Min. RVR 200 mts.
Aircraft pitch attitude = 4.7 degrees





Optimum mental and physical fitness results good quality of human performance. Minor ailments such as colds, fatigue and other such transient medical deficiencies must be taken into account and considered well before execution of such high performance tasks.



CAT 2 / 3 operation is mainly based upon an increased awareness factor. The grace and blessings of God is very important as the human intelligence would always remain limited. A stage comes in life when one ponders to realise Him and His kingdom."