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PANS-OPS Flight Procedure Design Training for CAAs

23 August – 03 September 2021





2 – General principles (Doc. 8168, Vol. 2, Part I, Section 2)





1. Approach segments

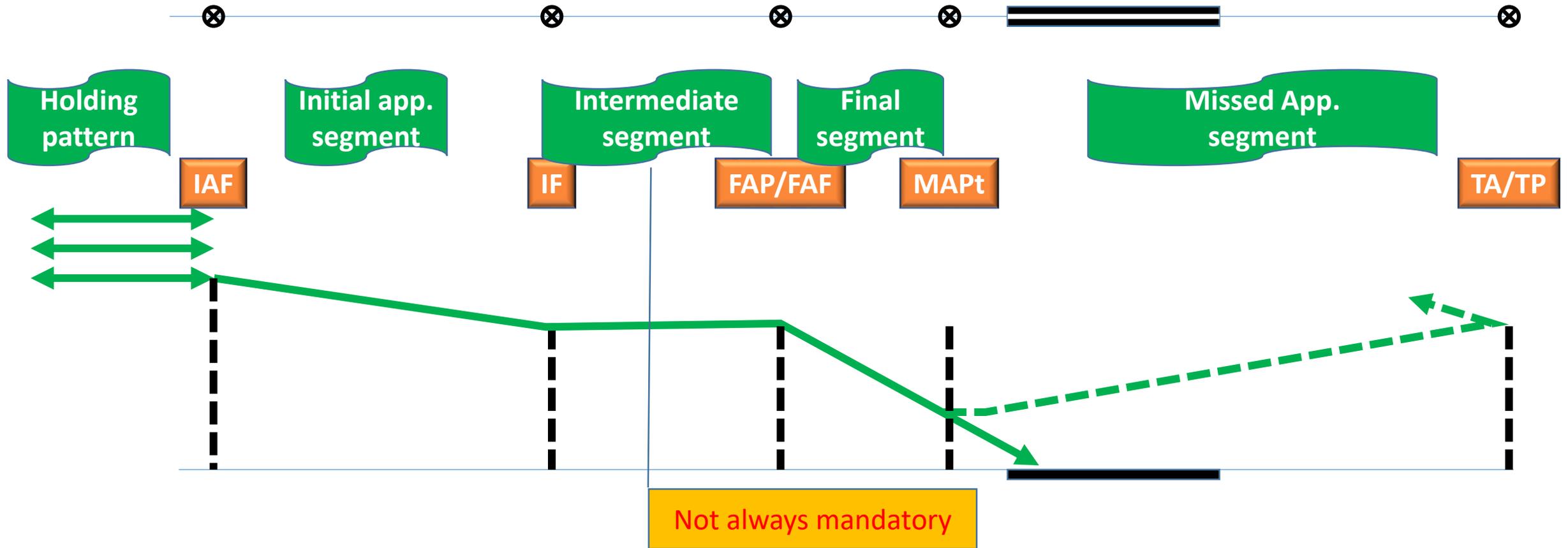
2. Nominal segment specific features

3. Protecting a segment



Approach segments

African Flight Procedure Programme (AFPP)



Nominal segment specific features

African Flight Procedure Programme (AFPP)

- Beginning and end of the segment
- Shape :
 - ☞ **Straight segments, arcs?**
- Track guidance?
- Applicable altitudes;
- Indicated airspeed (IAS);
- Minimum, optimum, maximum values: length, slope/gradient, bank angles (for turns);
- Alignment criteria between two consecutive segments.



Starting point/ending point or condition

African Flight Procedure Programme (AFPP)

Conventional

- At a fix:  
 -  Overhead station
 -  Intersections of information
- Intercepting an information
- At an altitude;
- At the end of a turn.

PBN

- At a waypoint:  
- At an altitude.



Nominal segment specific features

African Flight Procedure Programme (AFPP)

Shape

□ Conventional:

☞ Straight segments:

- Guided (VOR, NDB, LOC)
- Non-guided: Dead reckoning segment (DR);
- Combined guidance (ILS)

☞ Curved segments:

- DME Arcs (guided)

☞ Complex entity:

- combination of guided and none guided parts;
- Racetrack;
- Reversal turn.

□ PBN:

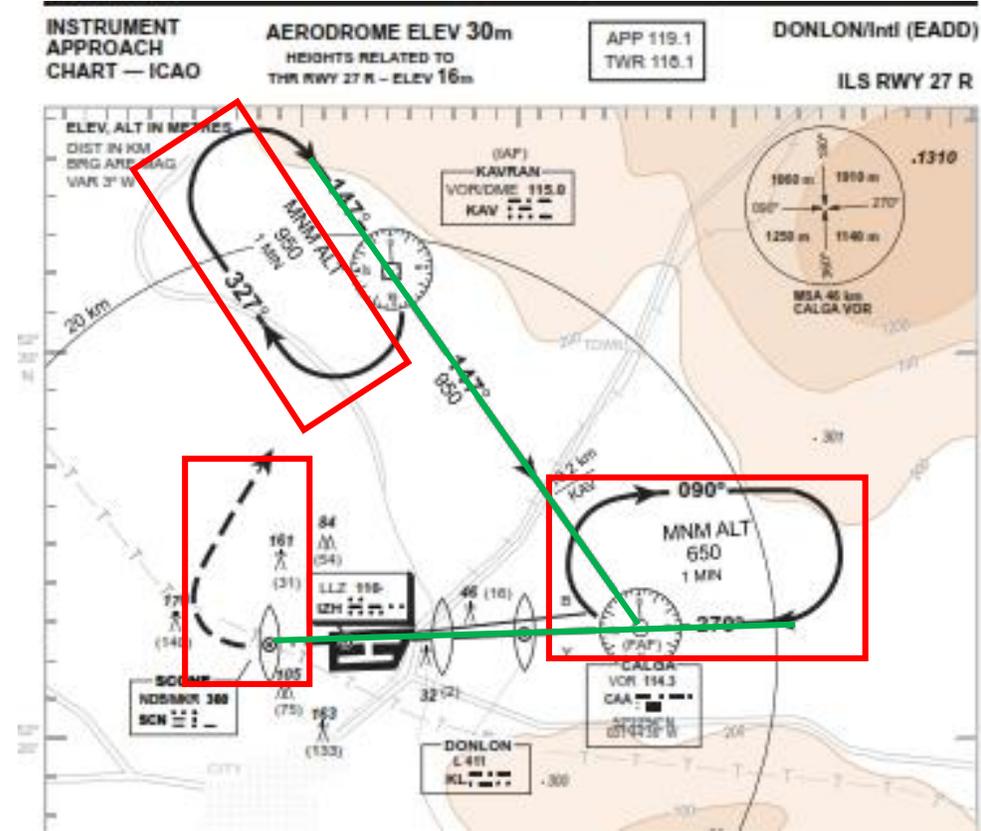
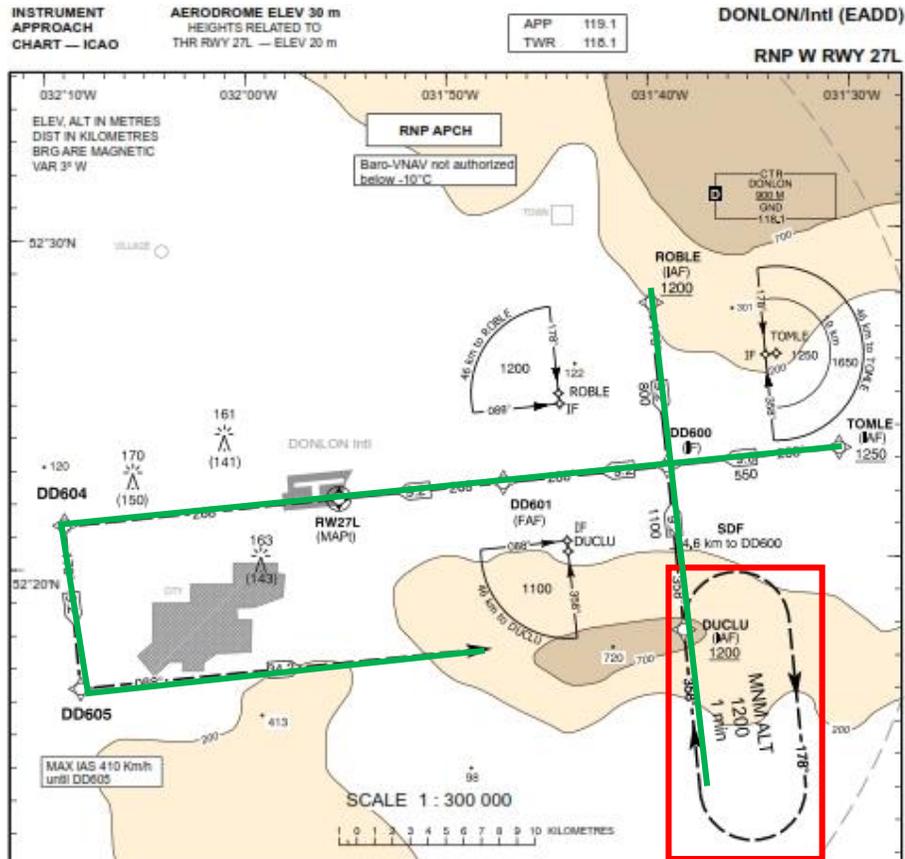
☞ Generally guided and straight:

- between two waypoints;

☞ Curved: RF turns, etc.

☞ Non-guided (partially):

- Missed approach and departures



Mix of **guided** and **non-guided** segments



□ Three types of altitudes:

☞ Maximum altitude (for a segment):

- Defined by the procedure designer;
- For the protection of a turn for e.g.
- Impacts the true airspeed, wind, turn radius, fix tolerance ...

☞ Procedure Altitude (PA) for a fix:

- Defined by the designer for operational needs;

☞ Minimum Obstacle Clearance Altitude (MOCA):

- $MOCA = \text{Altitude of controlling obstacle} + MOC$
- Should be only rounded up
- MOCA rules:
 - $MOCA \text{ of preceding segment} \leq MOC \text{ subsequent segment}$
 - $MOCA \leq PA$



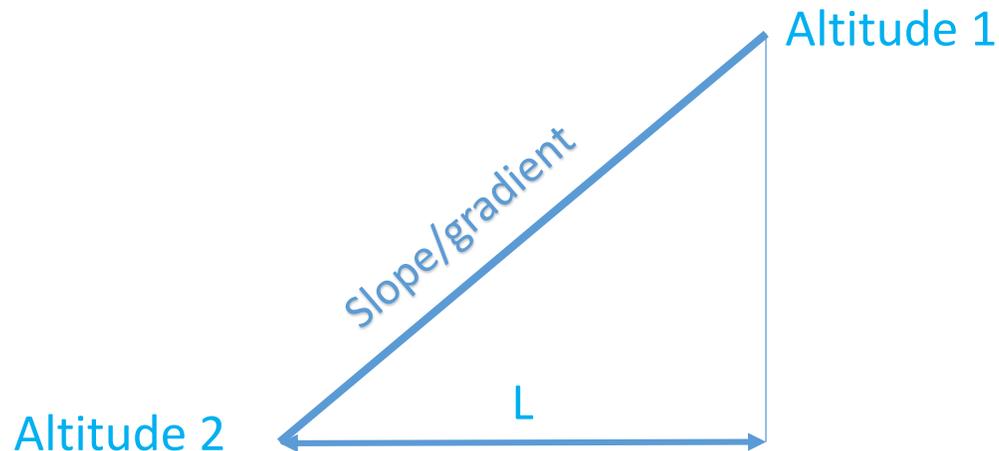
Indicated Airspeed (IAS)

African Flight Procedure Programme (AFPP)

Table I-4-1-2. Speeds (IAS) for procedure calculations in knots (kt)

Aircraft category	V_{at}	Range of speeds for initial approach	Range of final approach speeds	Max speeds for visual manoeuvring (circling)	Max speeds for missed approach	
					Intermediate	Final
A	<91	90/150(110*)	70/100	100	100	110
B	91/120	120/180(140*)	85/130	135	130	150
C	121/140	160/240	115/160	180	160	240
D	141/165	185/250	130/185	205	185	265
E	166/210	185/250	155/230	240	230	275
H	N/A	70/120**	60/90***	N/A	90	90
Cat H (PinS)***	N/A	70/120	60/90	NA	70 or 90	70 or 90

Slope versus gradient



$$\text{Slope} = \frac{(\text{Altitude 1} - \text{Altitude 2})}{L}$$

$$\text{Gradient} = \text{Slope} * 100$$

Notes:

- ☞ Slope is a tangent
- ☞ Gradient is expressed in %
- ☞ Both are computed for descending segments (value is 0 for flat segments)
- ☞ May be expressed in rate:
 - Rate = Δ altitude/time (ft/min)



□ Parameters used to draw the protection area:

- ☞ Nominal path;
- ☞ Fix tolerance;
- ☞ Flight technical tolerances (FTT);
- ☞ Maximum altitude;
- ☞ Range of IAS (maximum, minimum)
- ☞ Wind effect;
- ☞ Turn radius.

☐ All nominal segments protected horizontally:

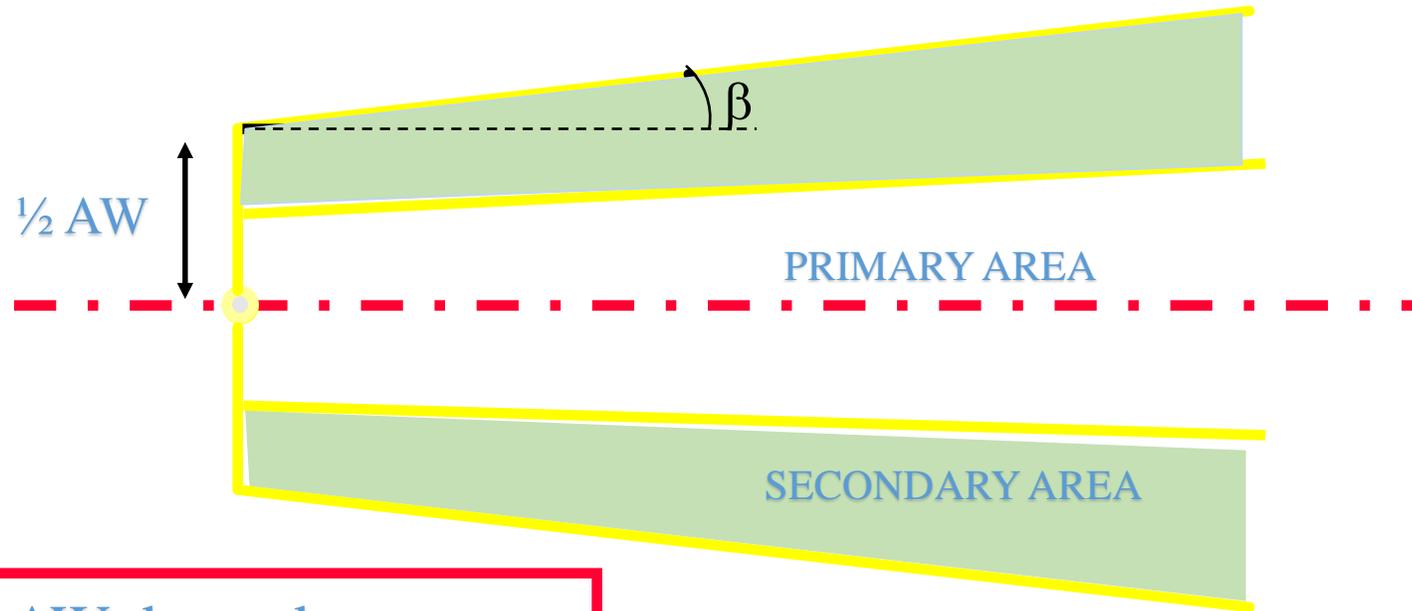
☞ Protection area (Statistical or additive methods):

- Primary area and
- Secondary area.

☐ and vertically:

☞ Minimum Obstacle Clearance (MOC):

- Different MOC values for each type of segment;
- Full MOC applied in primary area
- Decreasing MOC (linearly in secondary area);
- For guided tracks, Area Width (AW) of primary = AW of secondary

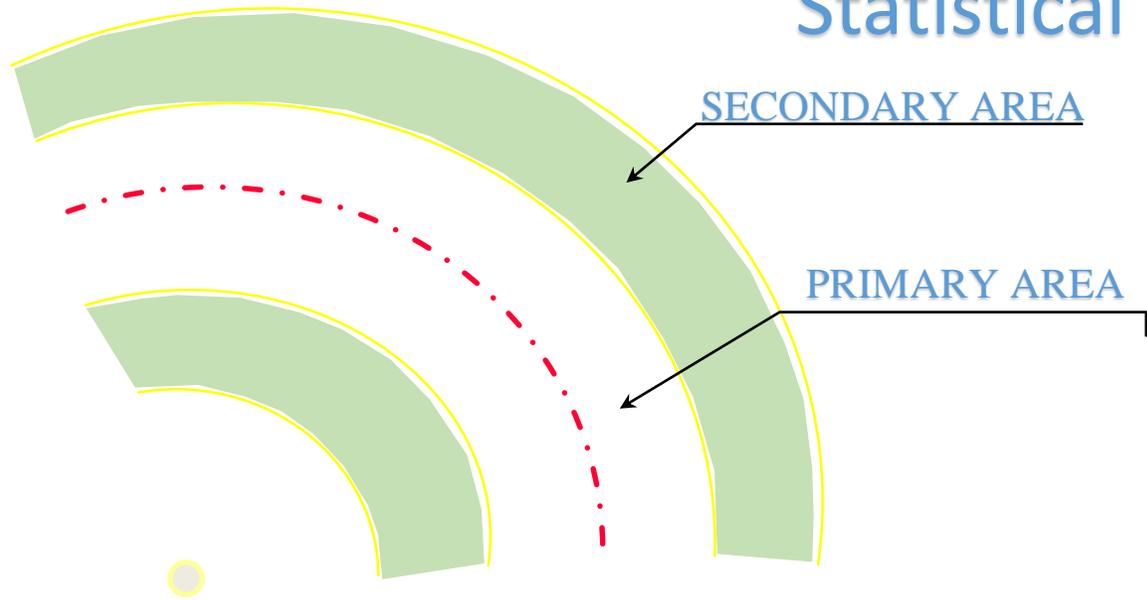


Does not depend on aircraft speed

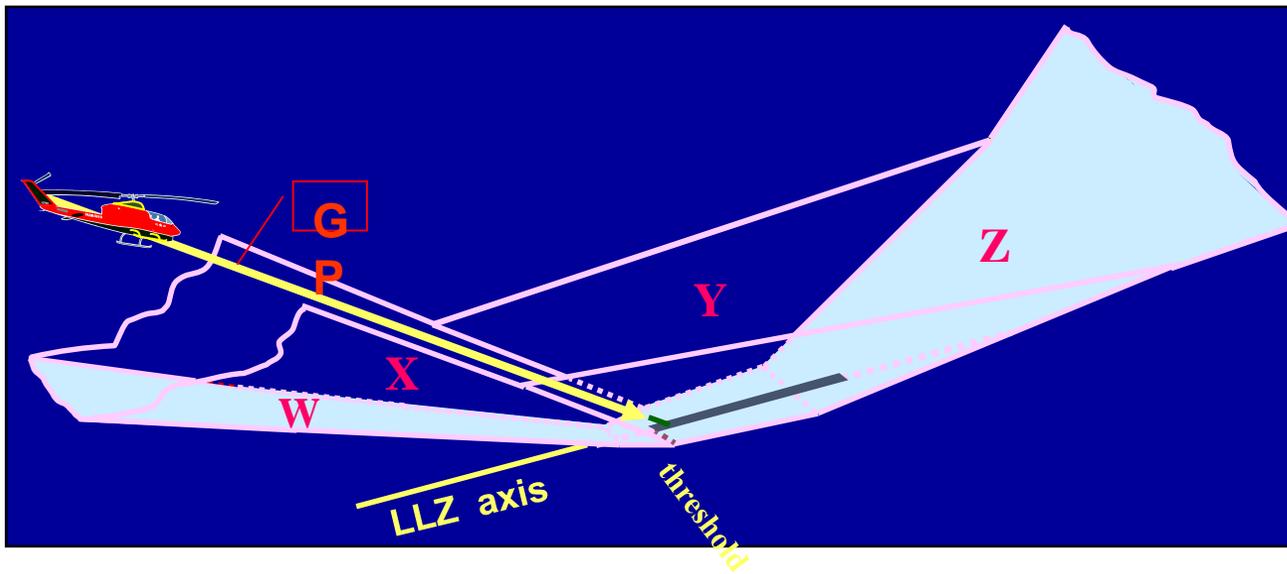
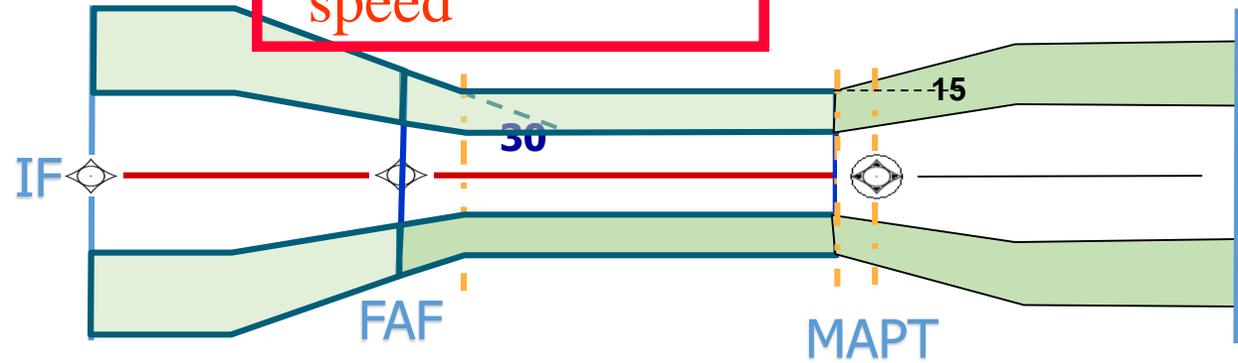
AW depends on type of facility and type of segment

β	ICAO
V O R	7.8 °
N D B	10.3 °

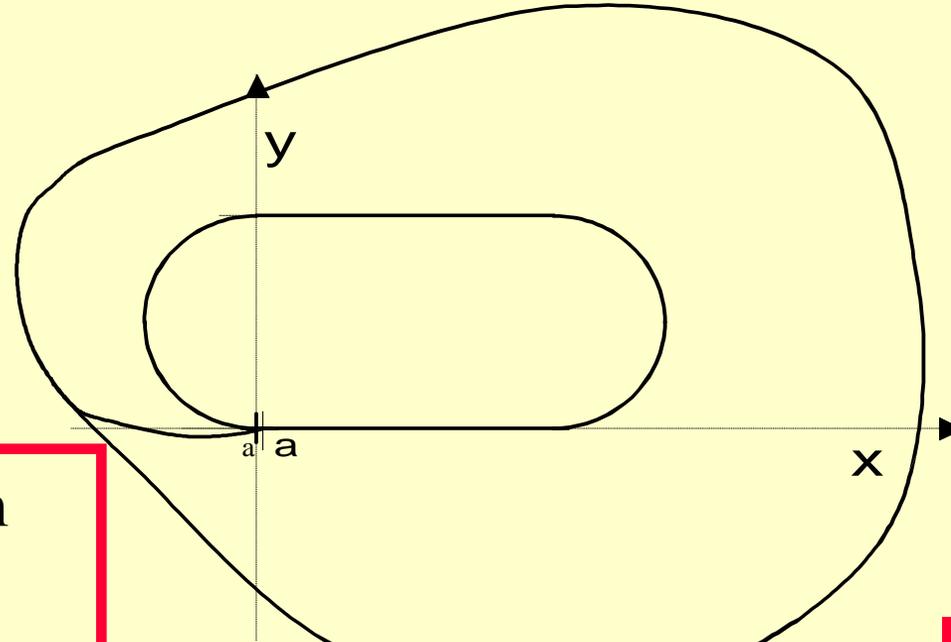
Statistical Method



Does not depend on aircraft speed

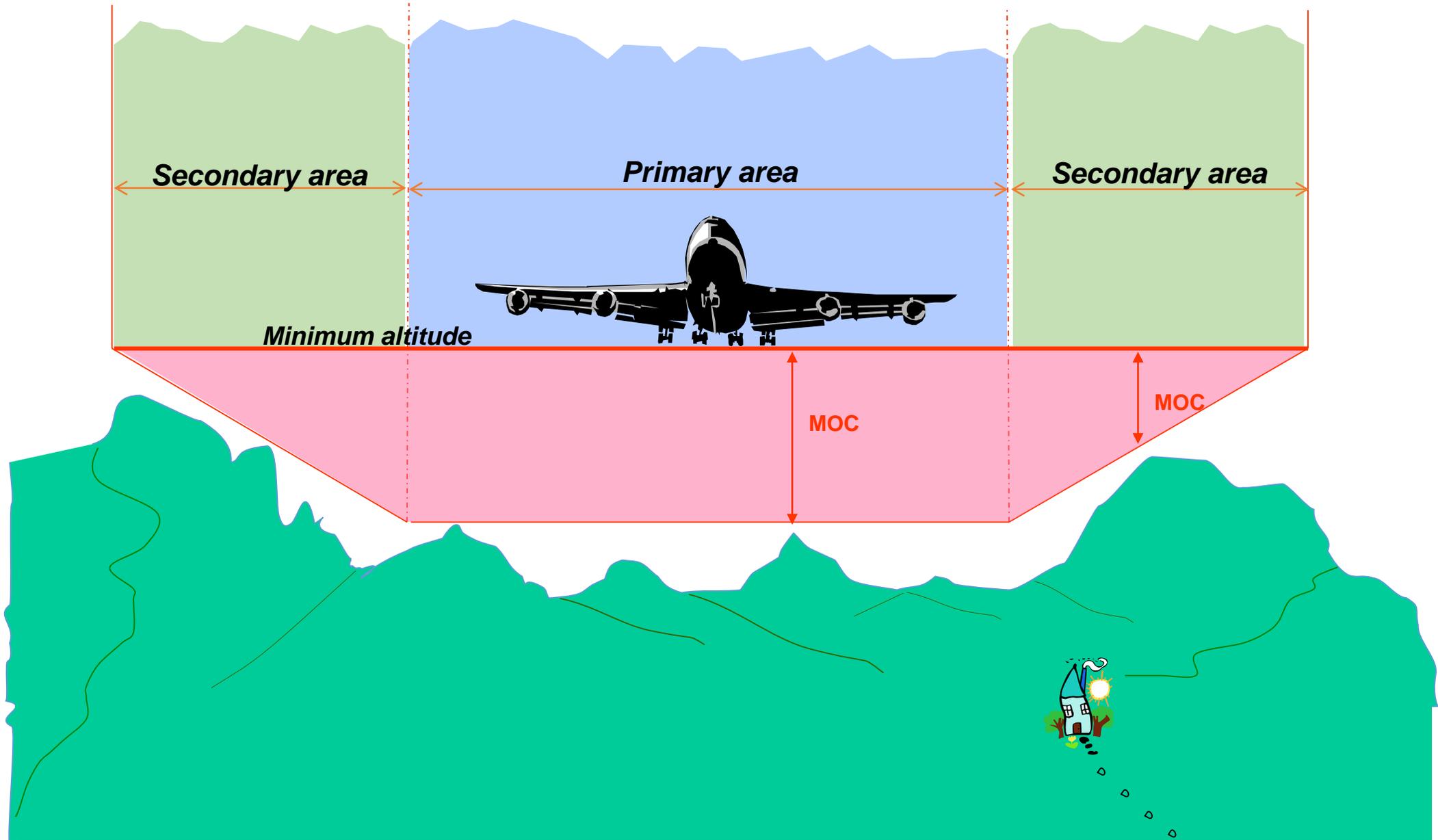


Additive Method



Beware of minimum
IAS effect
(Reversal turn)

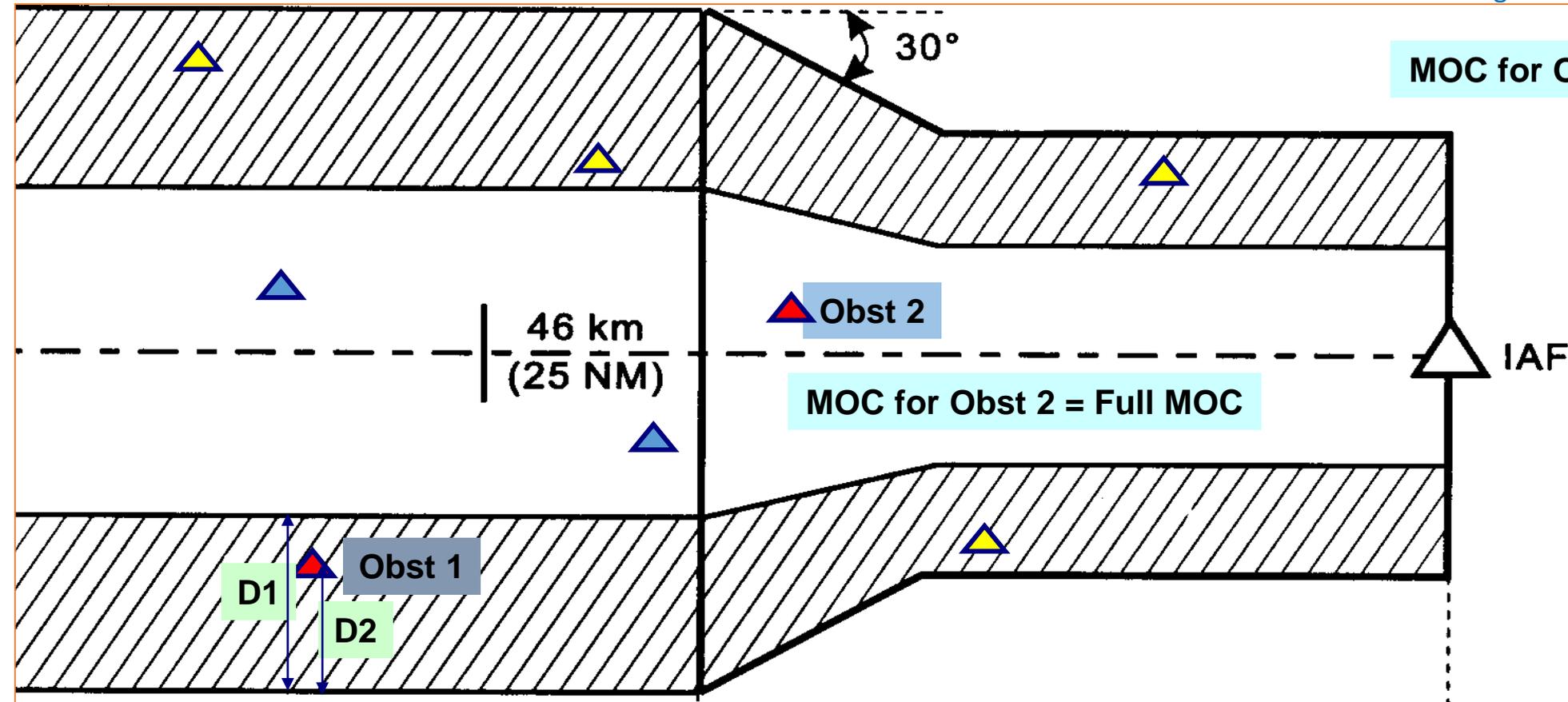
Depends on
aircraft speed





MOCA and MOC calculation

African Flight Procedure Programme (AFPP)



$$\text{MOCA} = \text{Max} [\text{AltObst} + \text{MOC for Obst}]$$



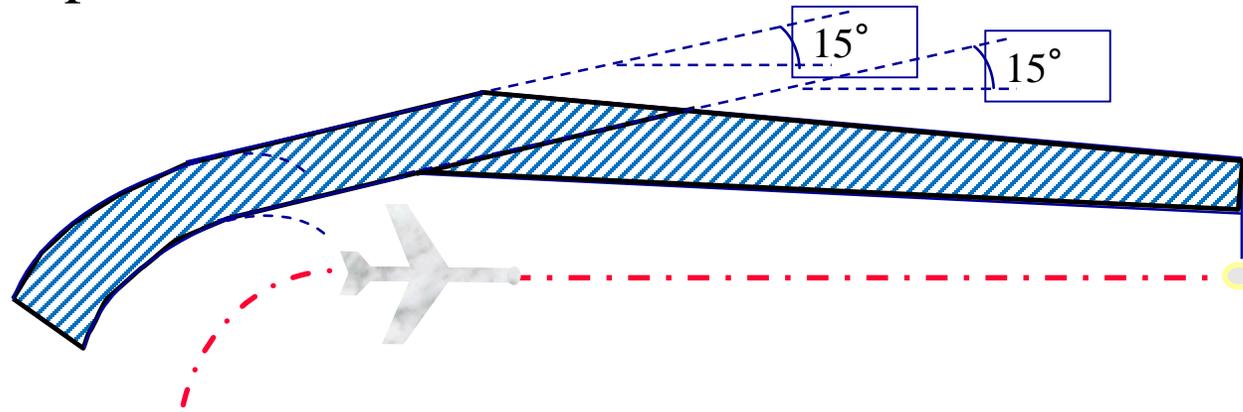
Protection of the turns

African Flight Procedure Programme (AFPP)

- Turns are transitions between two segments:
 - ☞ **Specific methods**
- Need creation of additional protection area;
- Applicable MOC;
- Nominal turn assumed to be flat during the turn.

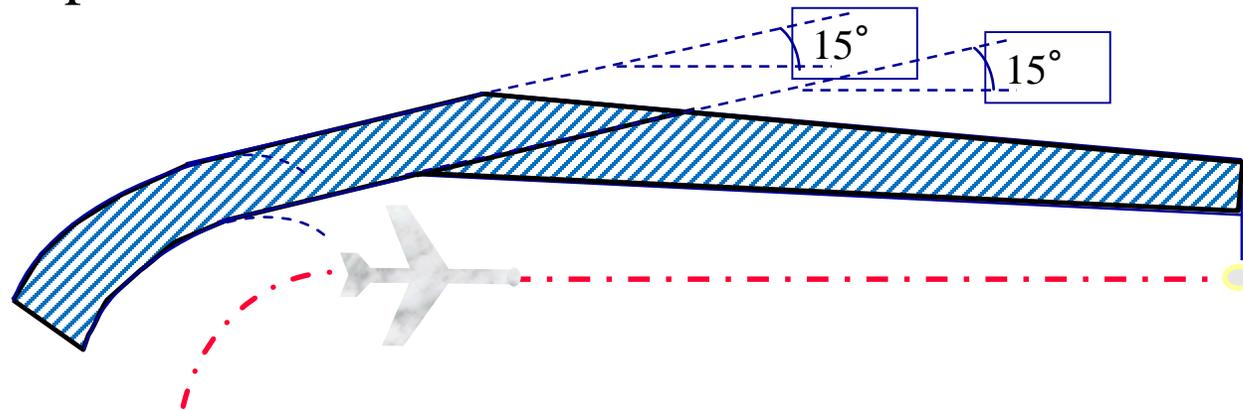
Outer spiral inside
straight protection
area

CLOSING THE AREA BY DIVERGING
TANGENT



Outer spiral inside
straight protection
area

CLOSING THE AREA BY DIVERGING
TANGENT





Comprehension check

African Flight Procedure Programme (AFPP)

How many segments do you have in an approach procedures:

3 segments;

4 segments;

4 or 5 segments;

5 segments

Which MOC value do you apply ?

In primary area?

In Secondary area?

List the methods used for the segment protection.



Questions:

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