PANS-OPS Demystified: Significance of Advanced Flight Procedures in Difficult Terrain

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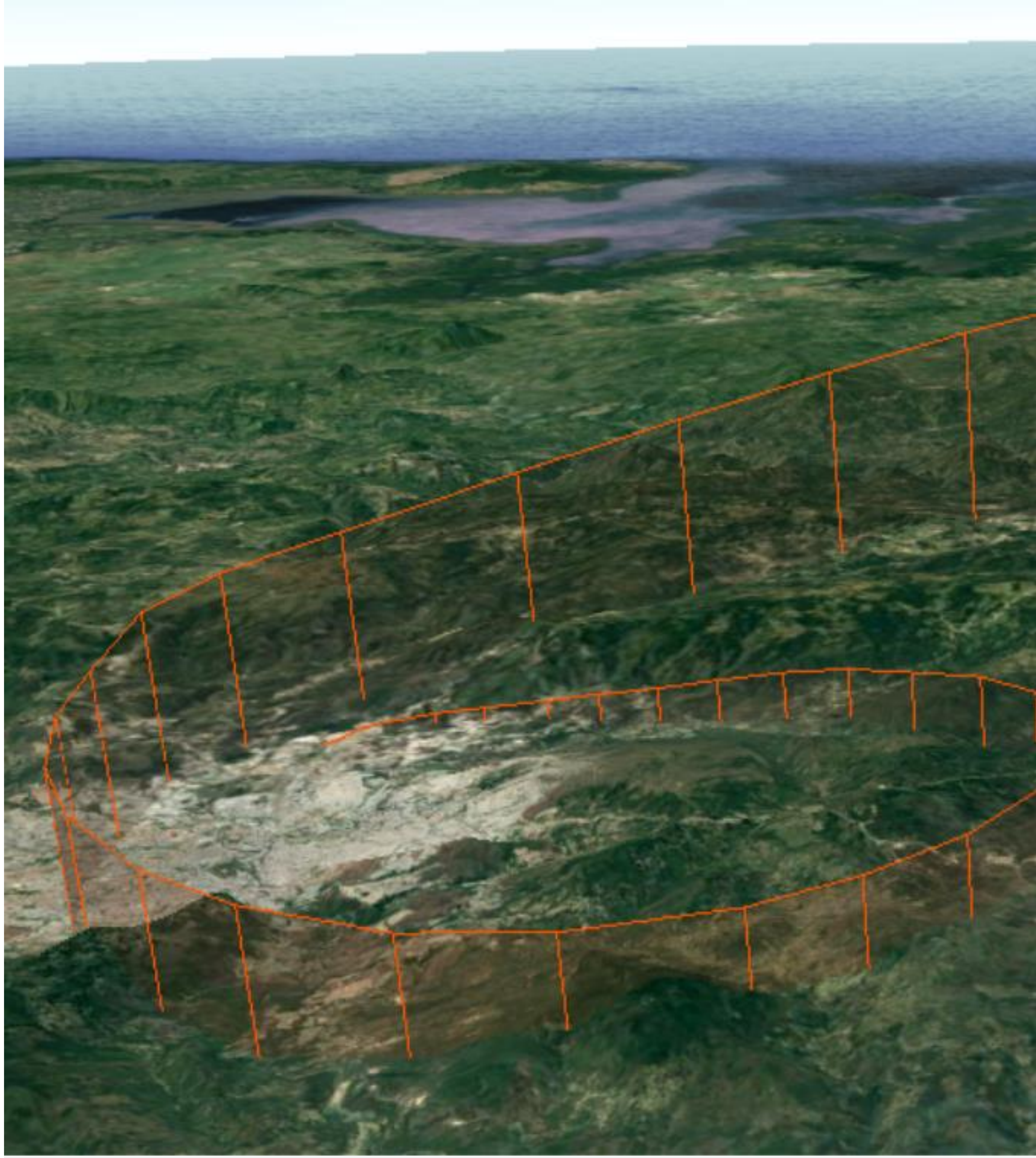
Table Of Content

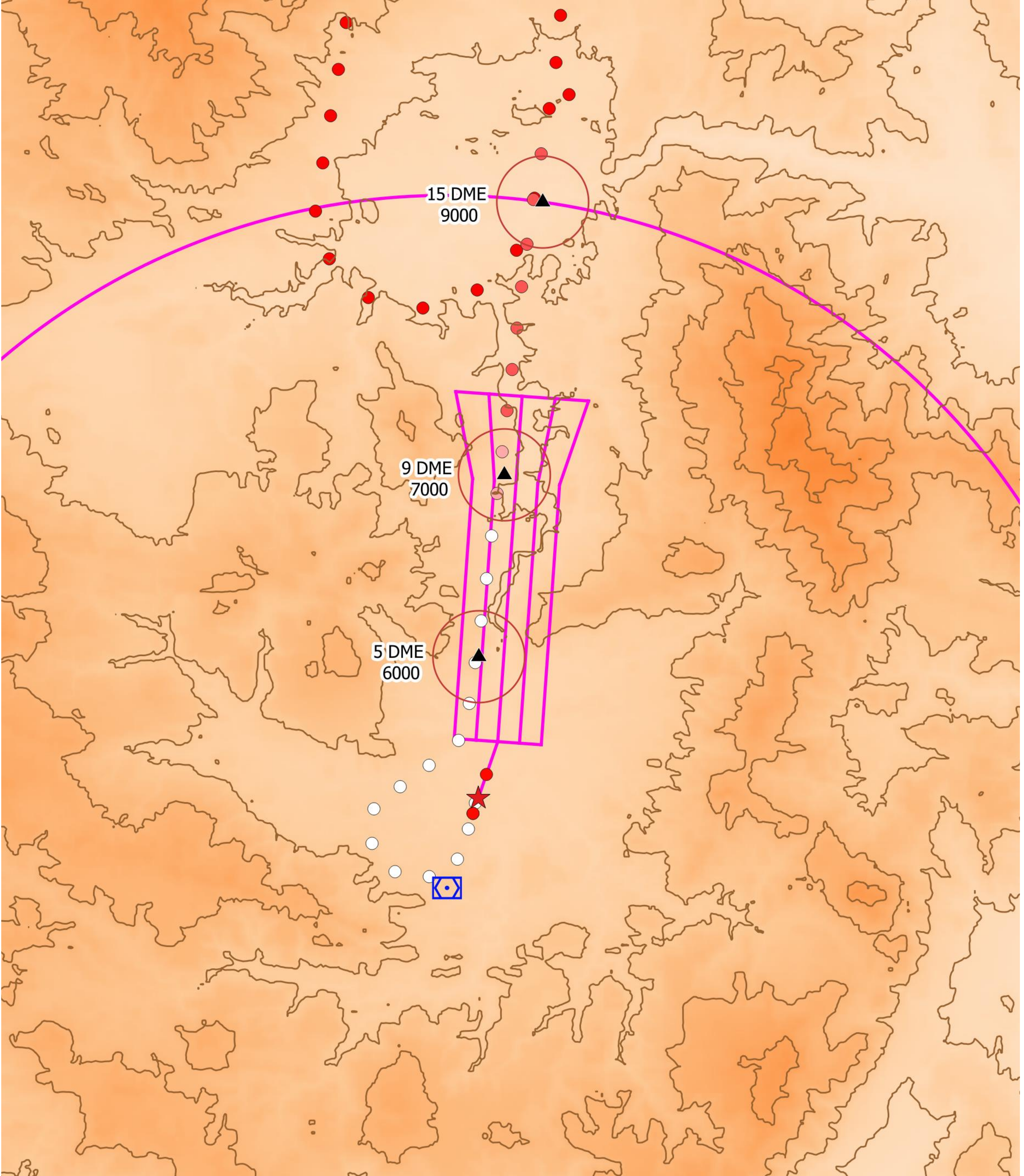


About Us

Expert Advice for when you need it the most

Instrument flight procedure design is a complex subject matter and if you combine it with the fact that you need to deal also with surveys, aeronautical information management, charting, ATC and other disciplines it can sometime become overwhelming.

FLYGHT7 mission is to accompany your vision of a better airspace that is able to cope with demand with safety always first.



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What We Do

FOCUS ON YOUR NEEDS

We are here to improve your operations as such, we will take time to listen and analyze the current baseline and your expected outcome

FIND SOLUTIONS FOR YOUR OPERATION

Once we have gathered the initial data be it on-site or through other means we will work together to bring solutions that benefit your operation

DELIVER

Everything we do is focused on bringing value and delivering the utmost quality, as we work together from day one we believe our service will improve your operations

Instrument Flight Procedure Design (IFPD) - PANS OPS

- Conventional Design
- PBN Design
- 5 year cycle review
- Procedure Audit “Independent Review”
- Training
- On the Job Training
- Aeronautical Obstacle Survey
- Obstacle Limitation Surfaces
- Ad-hoc consulting
- Procedure Flight Validation (Aircraft & Simulator Evaluation)

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Our Services

Aeronautical Information Management

- Aeronautical Charting
- AIXM
- FPL
- NOTAM
- AIP/eAIP
- Training

TRAINING AND SUPPORT

- Help for jump starting your operation with expert advice
- Consulting and Knowledge-transfer

WORKING TOGETHER

Main Stakeholders

AIR TRAFFIC SERVICES

Require the enhancement of operational safety and efficiency

INDUSTRY (Airlines)

Require the improvement of operations as well as reducing issues due to weather that increases revenue

GOAL IS TO HAVE A WIN-WIN SITUATION FOR ALL PARTIES INVOLVED

What is PANS-OPS?

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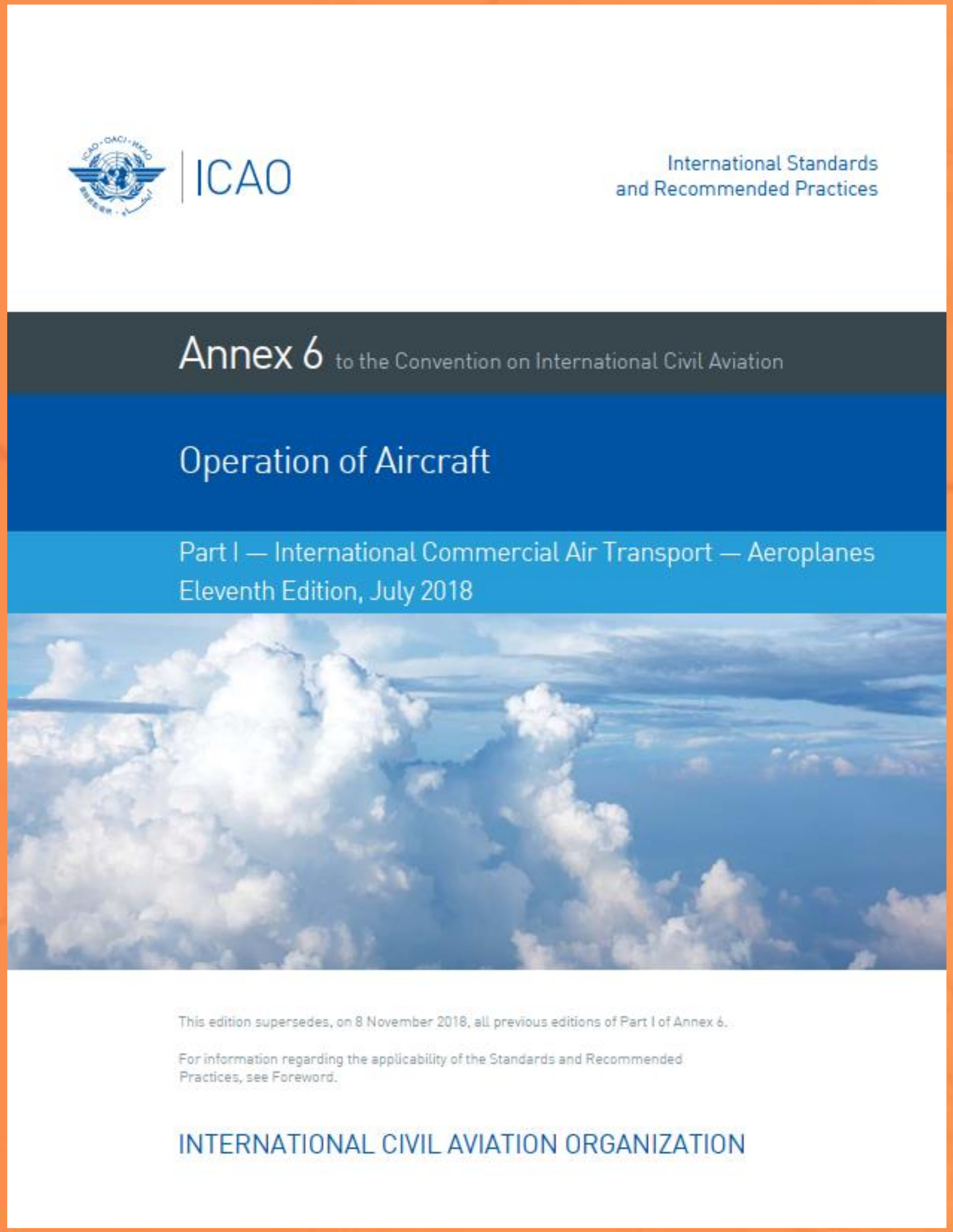
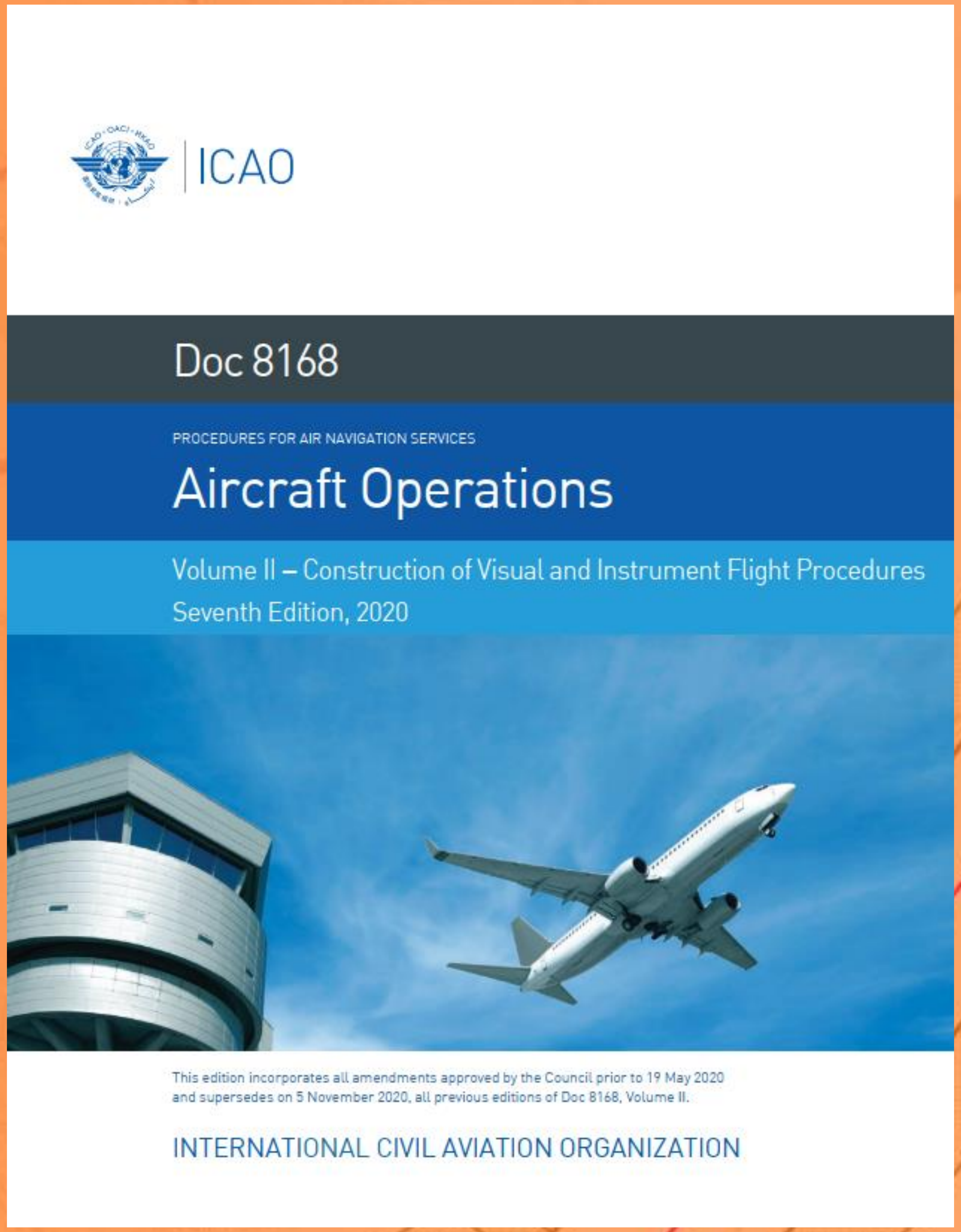
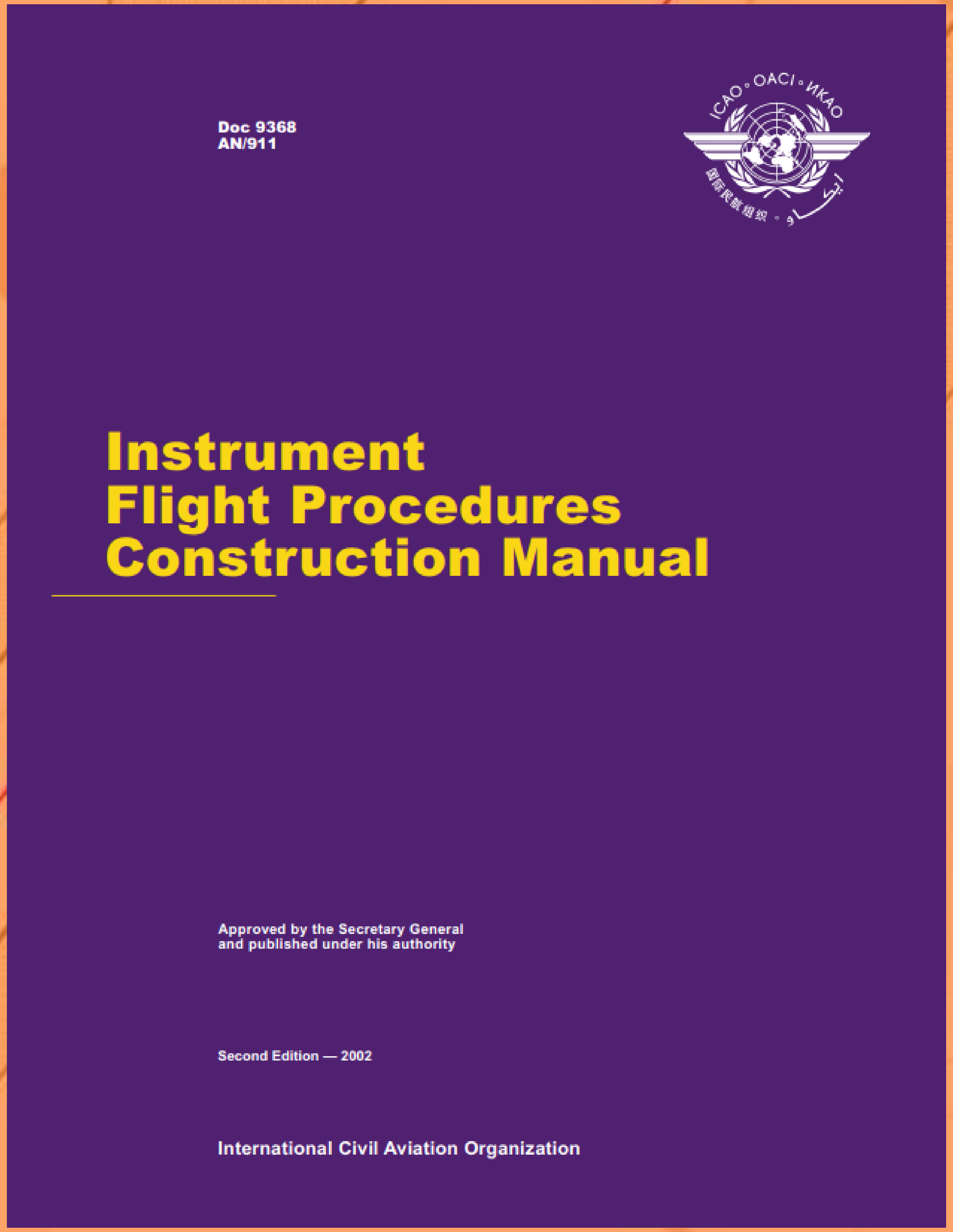
ICAO document hierarchy







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PANS OPS DOC 8168

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Instrument Flight Procedure Design

Definition and Areas where you can apply it

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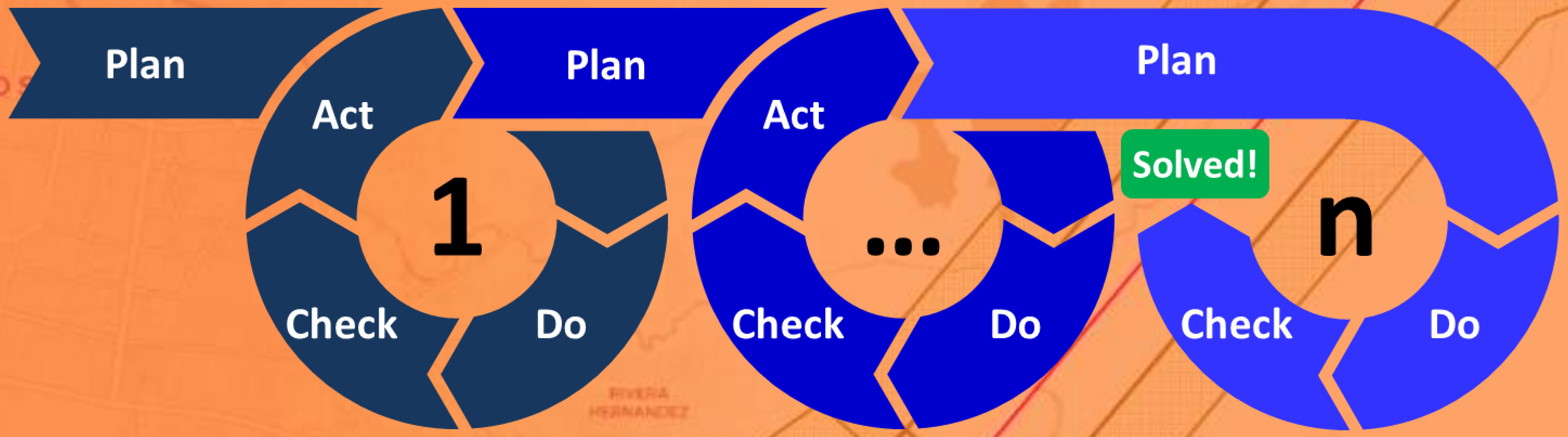
Definition

Instrument flight procedure design (IFPD) can be inferred from the definition provided for Instrument flight procedure design service (IFPDS) and we can say that IFPD is involved in the design, documentation, validation, continuous maintenance and periodic review of instrument flight procedures necessary for the safety, regularity and efficiency of air navigation



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Areas where IFPD can be used

- IFP Design
- 5-Yearly reviews
- OLS review
- Feasibility Studies

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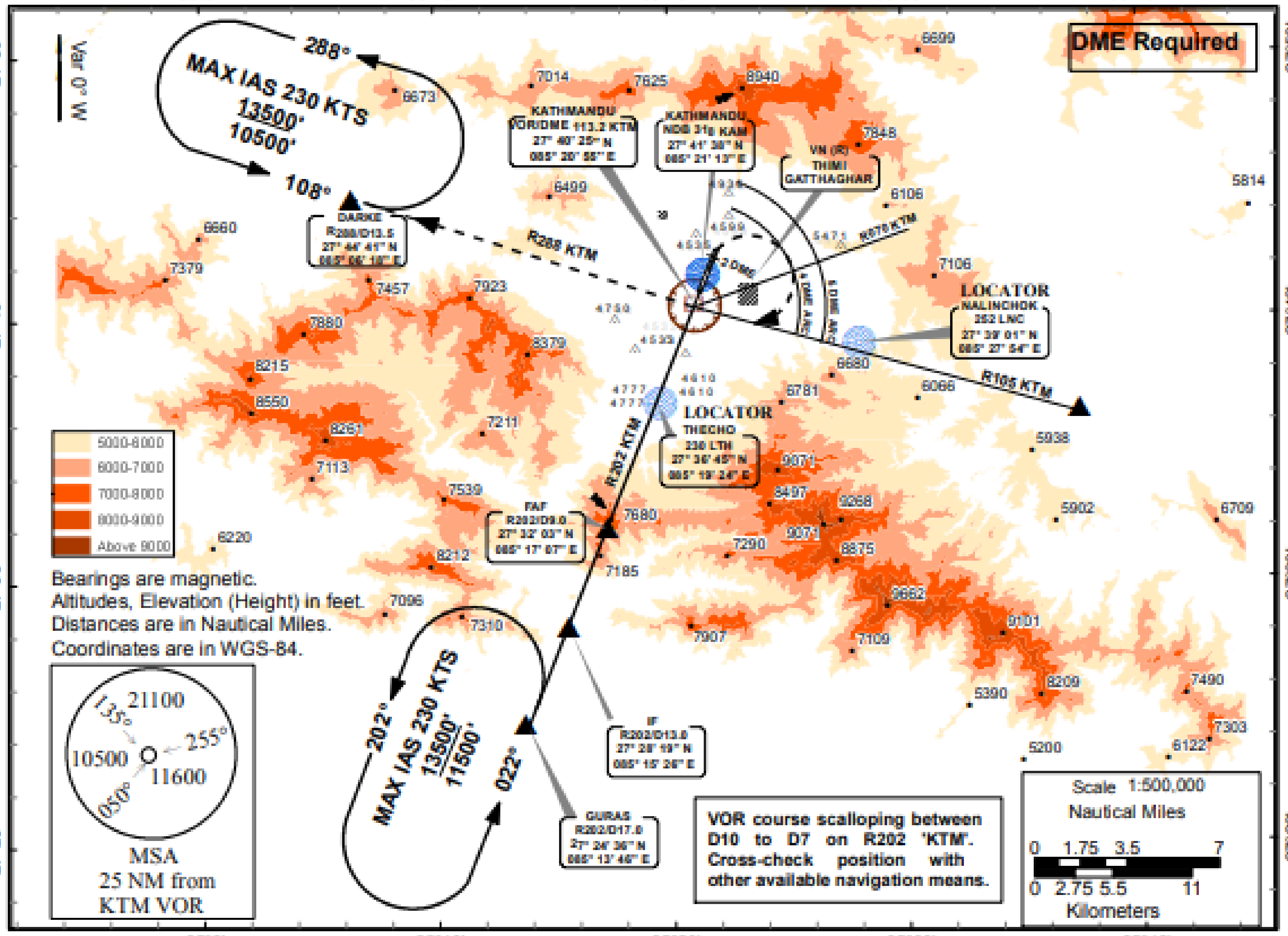
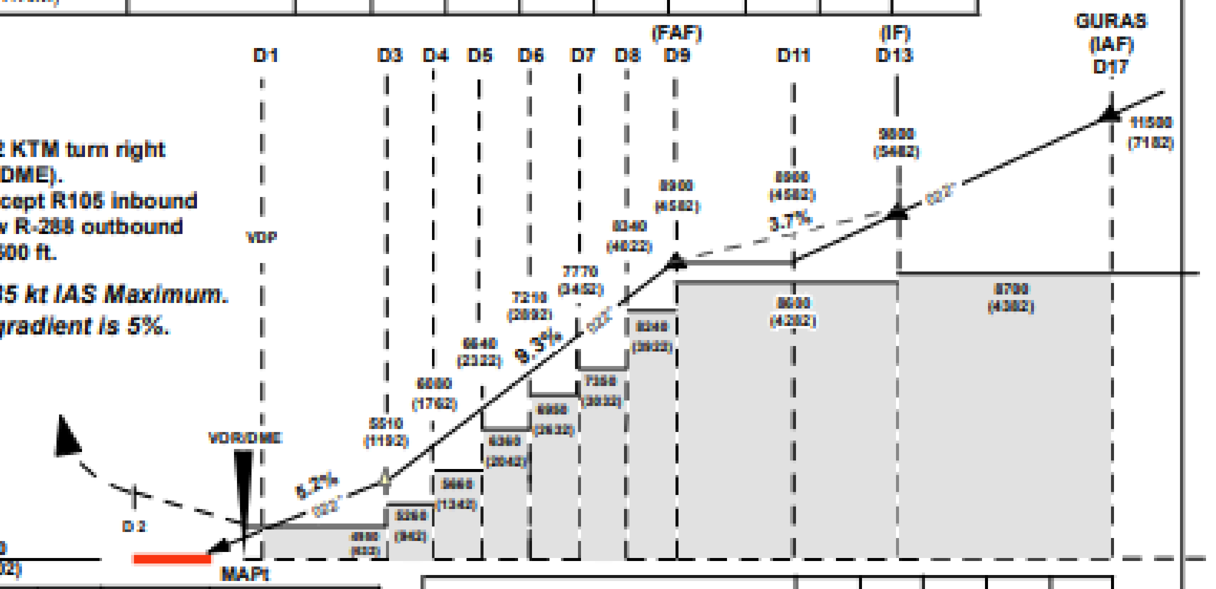
INSTRUMENT APPROACH CHART - ICAO	AERODROME ELEV 4395' HEIGHTS RELATED TO THR-RWY 02 - ELEV 4320' VARIATION 0° W (2010)	APP 120.6 MHZ TWR 118.1 MHZ GND 121.9 MHZ	KATHMANDU/NEPAL Tribhuwan International Airport VOR RWY 02 VOR 'KTM' 113.2



RECOMMENDED PROFILE	DIST BY DME	9	8	7	6	5	4	3	2	0.9
Final Gradient FAF To 3 DME 9.3% (5.5°) (565 FT/NM) 3 DME to THR 5.2% (3.0°) (316 FT/NM)	ALT (HGT)	8900 (4582)	8340 (4022)	7770 (3452)	7210 (2892)	6640 (2322)	6080 (1762)	5510 (1192)	5200 (882)	4950 (632)

Missed Approach:
Climb straight ahead. At 2 DME on R022 KTM turn right to intercept 4 DME arc (not to exceed 5 DME). Crossing R070 KTM turn right and intercept R105 inbound to 'KTM' VOR at or above 7500 ft. Follow R-288 outbound to DARKE (D13.5/R-288) at or above 10500 ft.

Missed approach turn limited to 185 kt IAS Maximum.
Minimum Missed approach climb gradient is 5%.

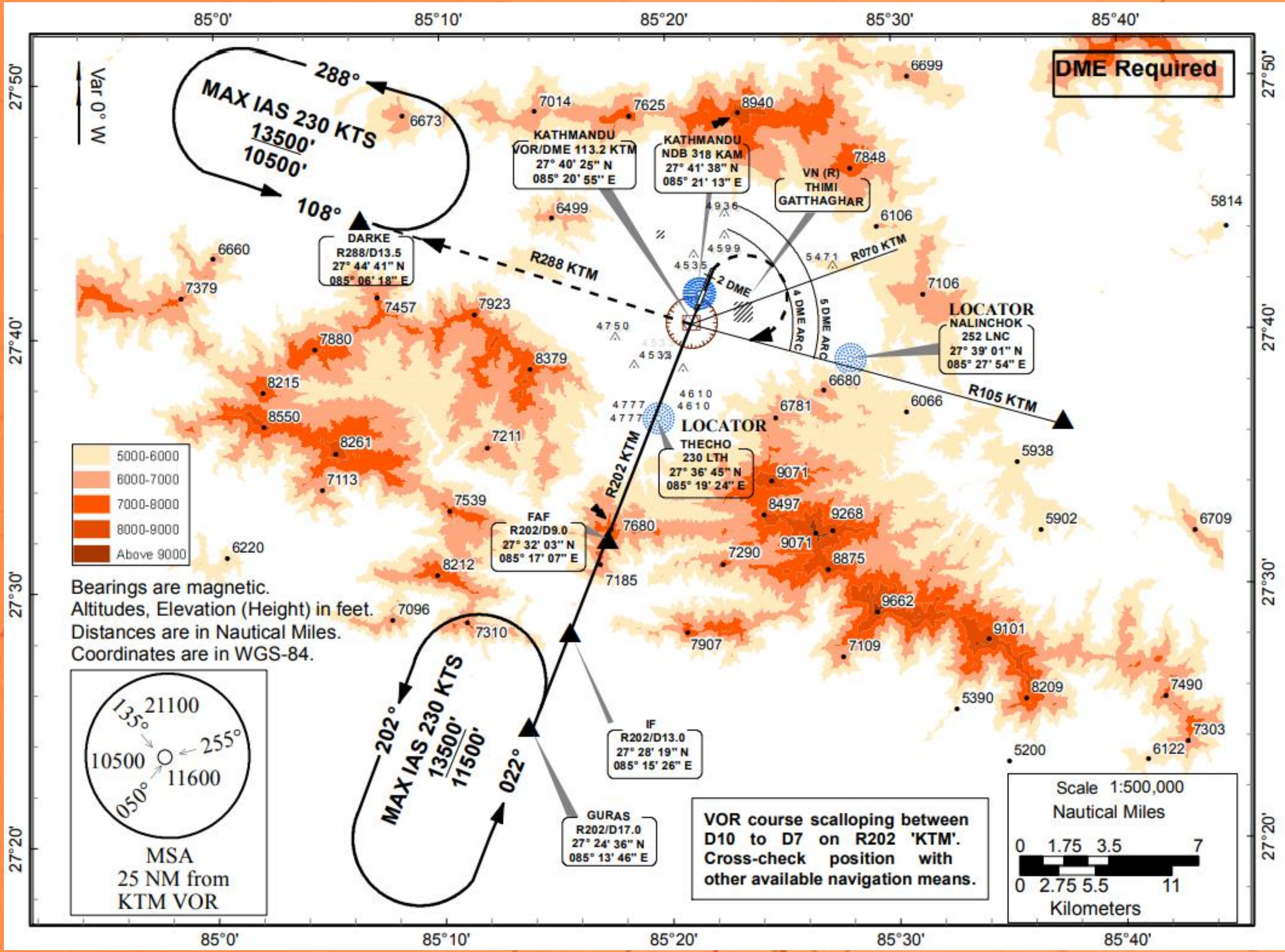


CATEGORY		A		B	C		D	
		OCA (OCH)	VISIBILITY		OCA (OCH)	VISIBILITY	OCA (OCH)	VISIBILITY
Straight-in	Full	4950 (632)	1600 m		4950 (632)	2800 m	4950 (632)	3200 m
	ALS Out		2400 m			3600 m		4000 m
Circling		4950 (632)	2400 m		NOT AUTHORIZED			
		CIRCLING NOT AUTHORIZED AT NIGHT						

Ground Speed (Knots)	60	90	120	150	180
D3 to MAPt : 3 NM (min:sec)	3:00	2:00	1:30	1:12	1:00
Rate of descent (ft/min) at 5.2%	316	474	632	790	948

***Note:** From 13D to 9D, aircraft may descend with constant descent gradient of 3.7% .*

** Descent gradient from D9 to D3 does not meet standard criteria.*


DME Required
Var 0° W
288°
MAX IAS 230 KTS
13500'
10500'
108°
DARKE
R288/D13.5
27° 44' 41'' N
085° 06' 18'' E
R288 KTM
KATHMANDU
VOR/DME 113.2 KTM
27° 40' 25'' N
085° 20' 55'' E
KATHMANDU
NDB 318 KAM
27° 41' 38'' N
085° 21' 13'' E
VN (R)
THIMI
GATTHAGHAR
2 DME
4 DME ARC
5 DME ARC
R070 KTM
LOCATOR
NALINCHOK
252 LNC
27° 39' 01'' N
085° 27' 54'' E
R105 KTM
LOCATOR
THECHO
230 LTH
27° 36' 45'' N
085° 19' 24'' E
R202 KTM
FAF
R202/D9.0
27° 32' 03'' N
085° 17' 07'' E
IF
R202/D13.0
27° 28' 19'' N
085° 15' 26'' E
GURAS
R202/D17.0
27° 24' 36'' N
085° 13' 46'' E
202°
MAX IAS 230 KTS
13500'
11500'
022°
5000-6000
6000-7000
7000-8000
8000-9000
Above 9000
Bearings are magnetic.
Altitudes, Elevation (Height) in feet.
Distances are in Nautical Miles.
Coordinates are in WGS-84.
21100
135°
255°
10500
11600
050°
MSA
25 NM from
KTM VOR
VOR course scalloping between D10 to D7 on R202 'KTM'. Cross-check position with other available navigation means.
Scale 1:500,000
Nautical Miles
0 1.75 3.5 7
0 2.75 5.5 11
Kilometers
85°0'
85°10'
85°20'
85°30'
85°40'
27°50'
27°40'
27°30'
27°20'
6699
7014
7625
8940
6673
7848
5814
6499
6106
6660
7379
7106
7923
7457
7880
8379
6680
8215
6066
6781
8550
7211
8261
5938
9071
7113
8497
9268
7539
5902
6709
7680
6220
9071
7290
8875
8212
7185
9662
7096
7310
9101
7907
7109
8209
7490
5390
7303
5200
6122

Instrument approach procedure (IAP)

A series of predetermined maneuvers by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en-route obstacle clearance criteria apply.

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Conventional vs RNAV vs PBN

What is the difference?

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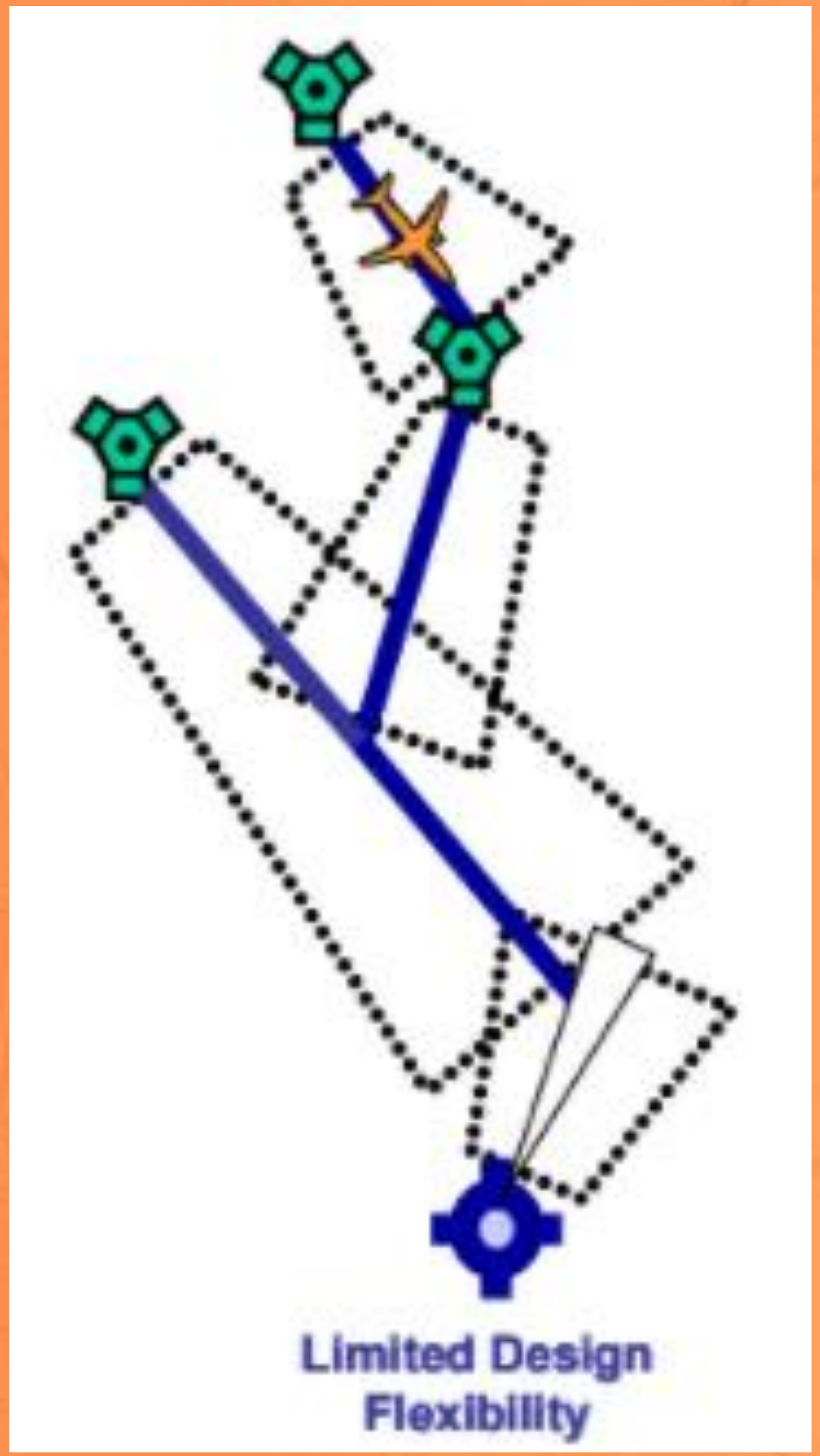
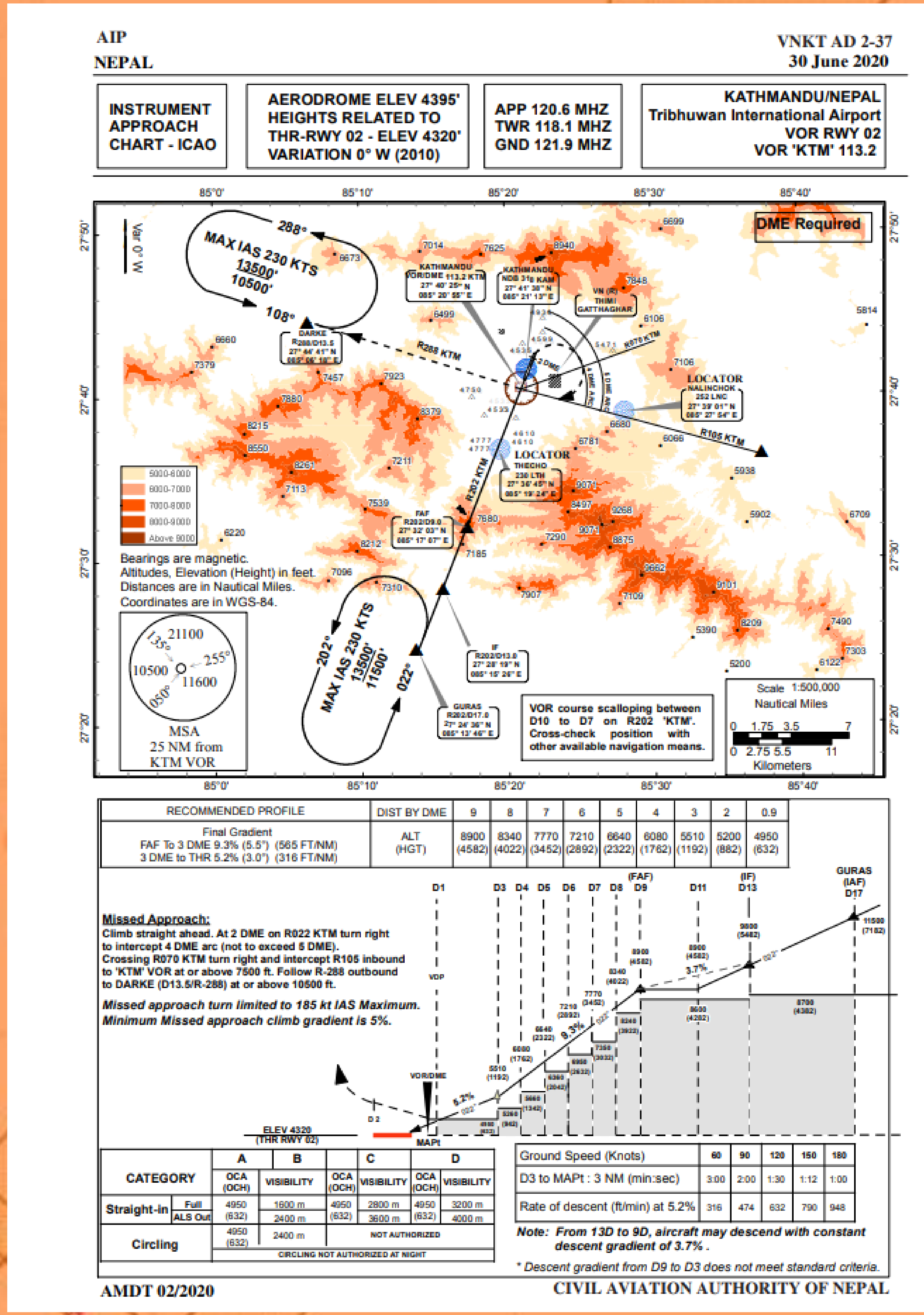
Conventional Navigation





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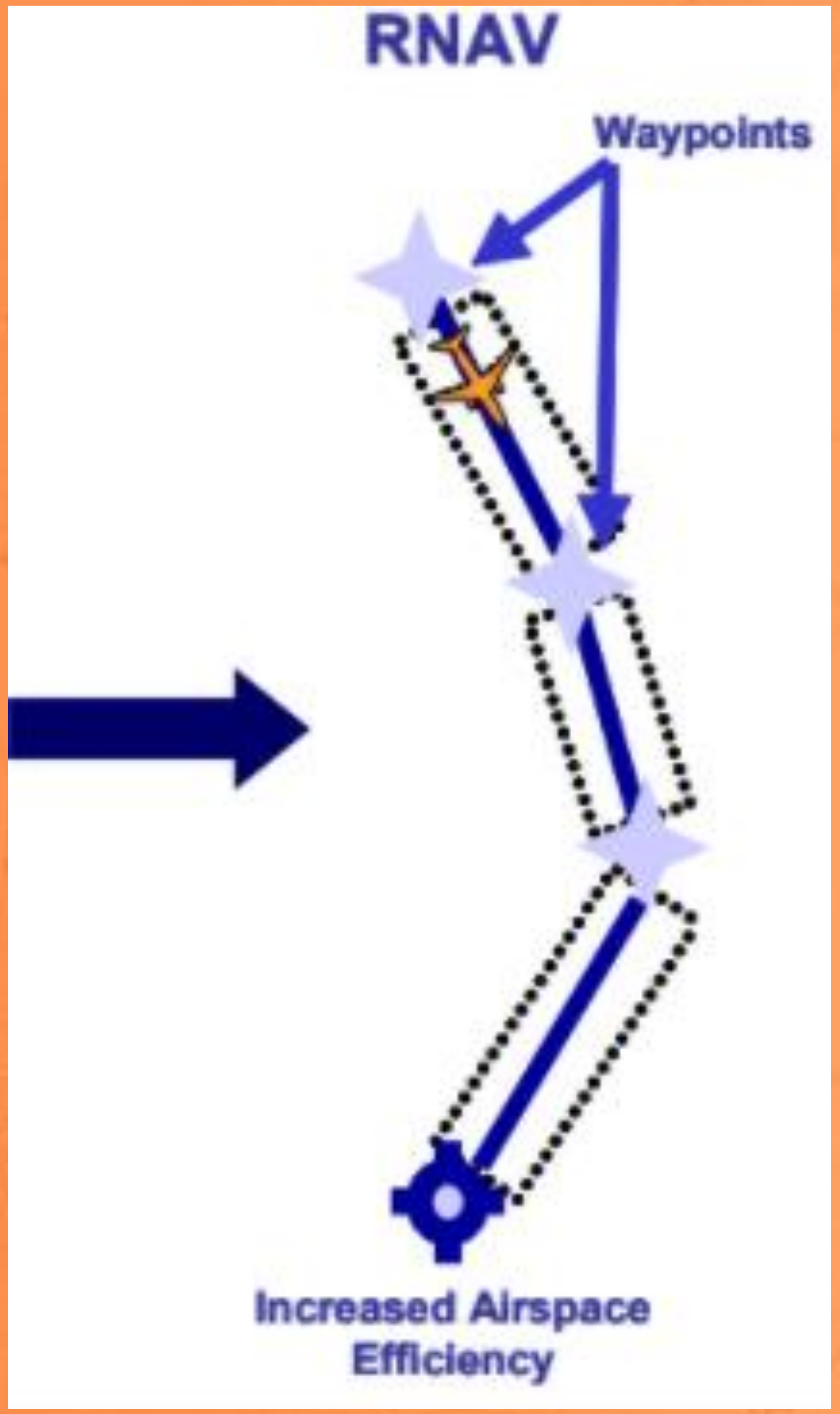
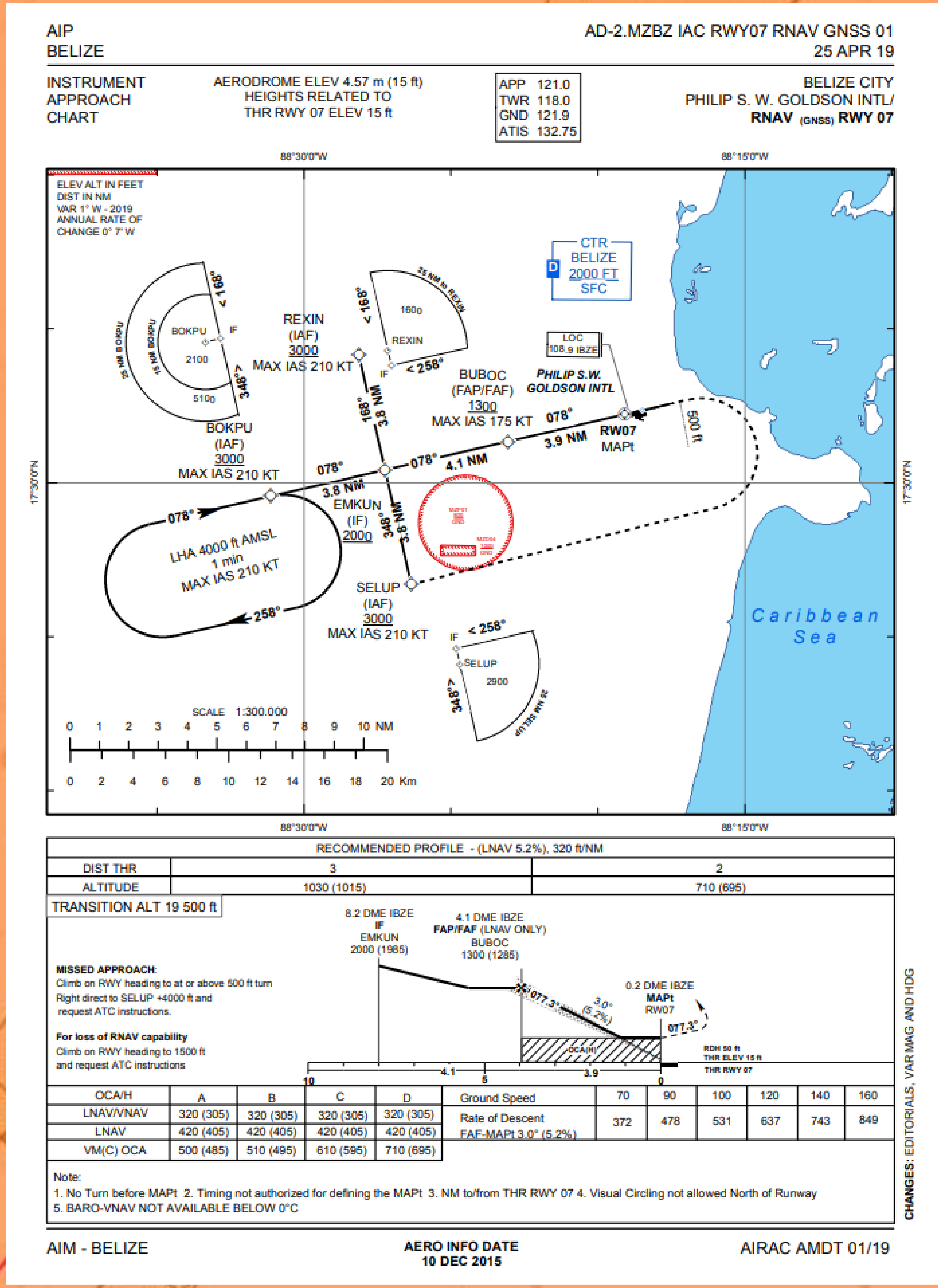
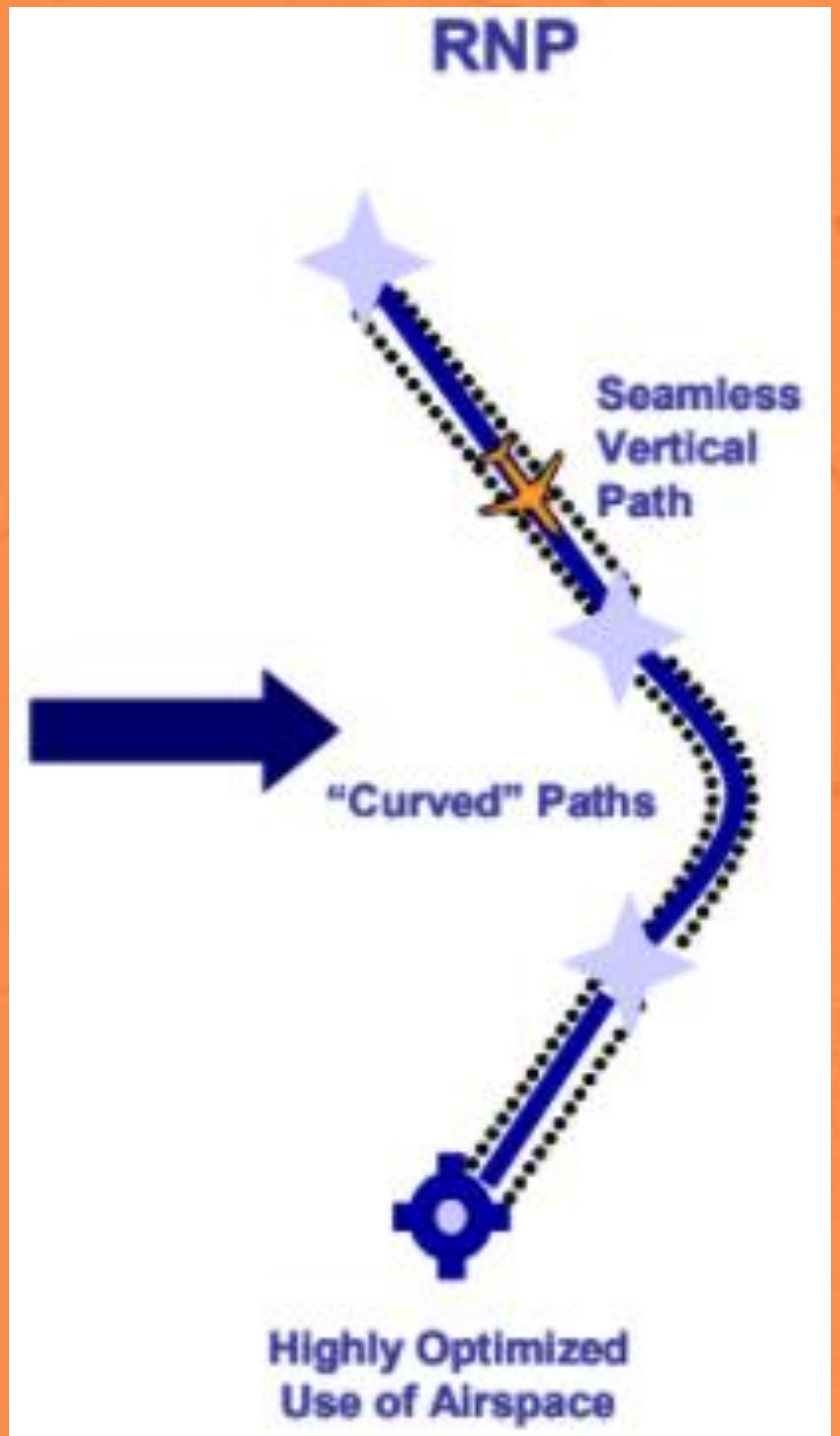
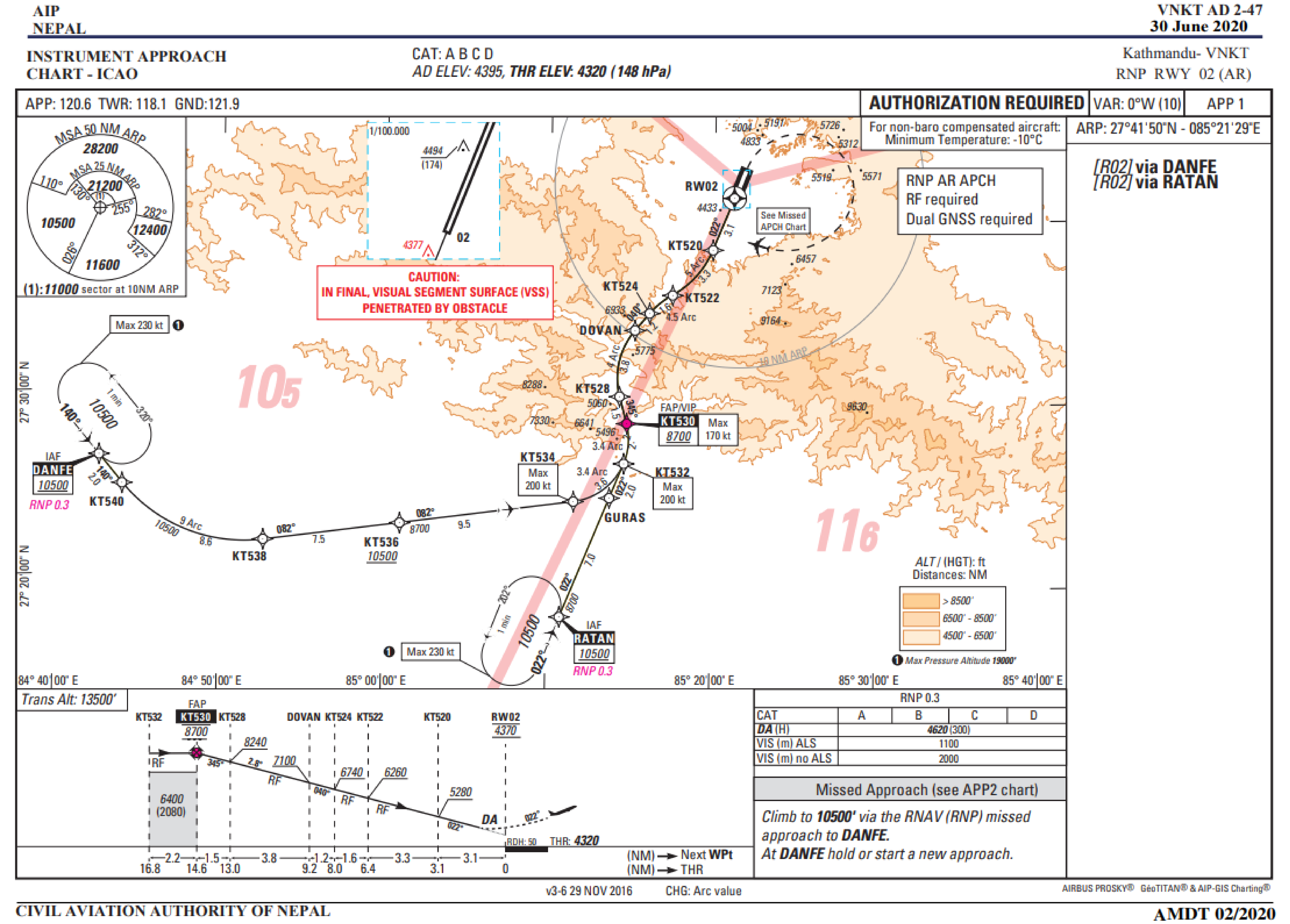
Area Navigation (RNAV)





Required Navigation Performance (RNP)





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Basic PANS-OPS Principles

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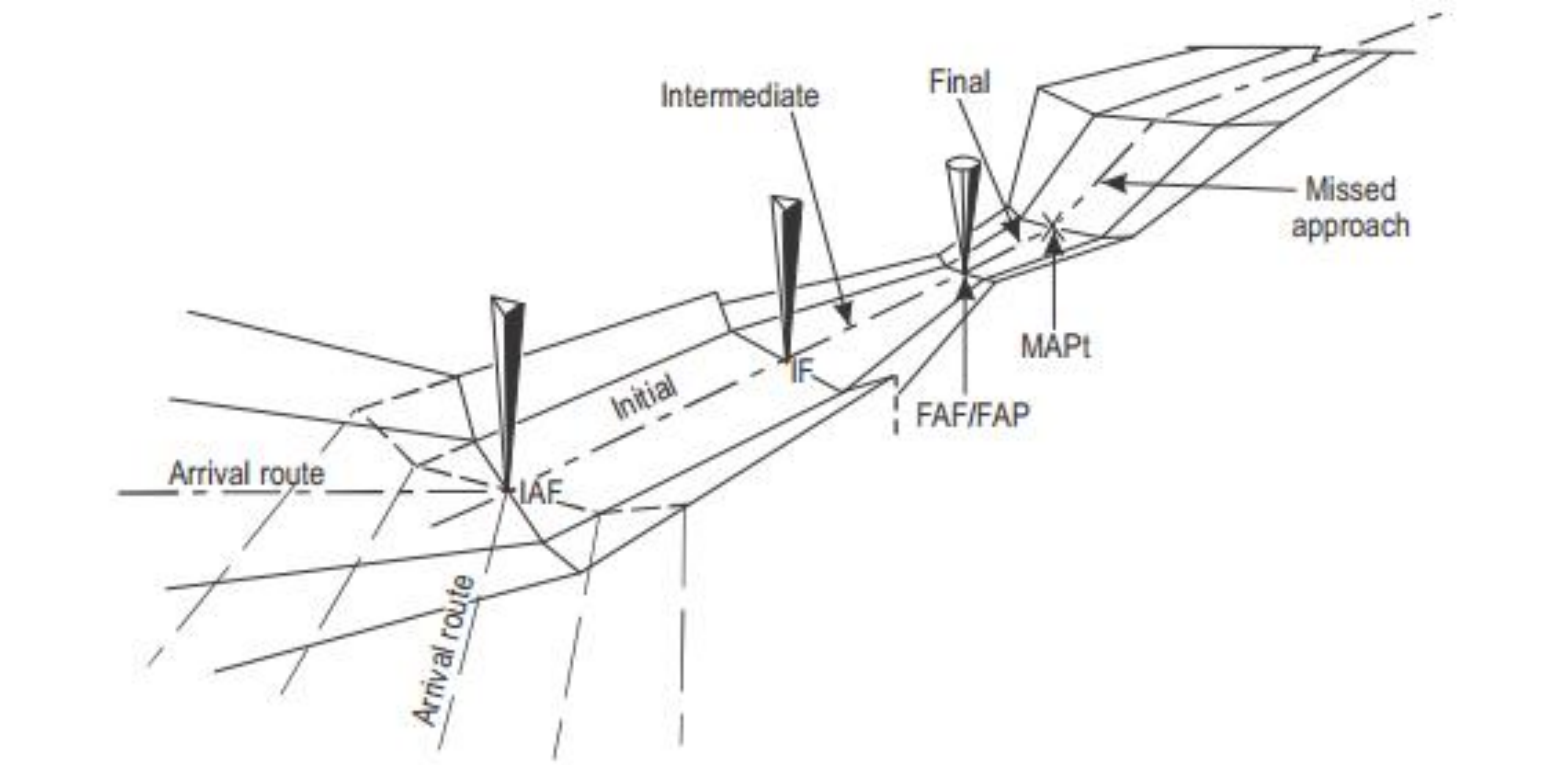
Important

The design of procedures in accordance with PANS-OPS criteria assumes normal operations.

It is the responsibility of the operator to provide contingency procedures for abnormal and emergency operations

Segments of Instrument Approach Procedures



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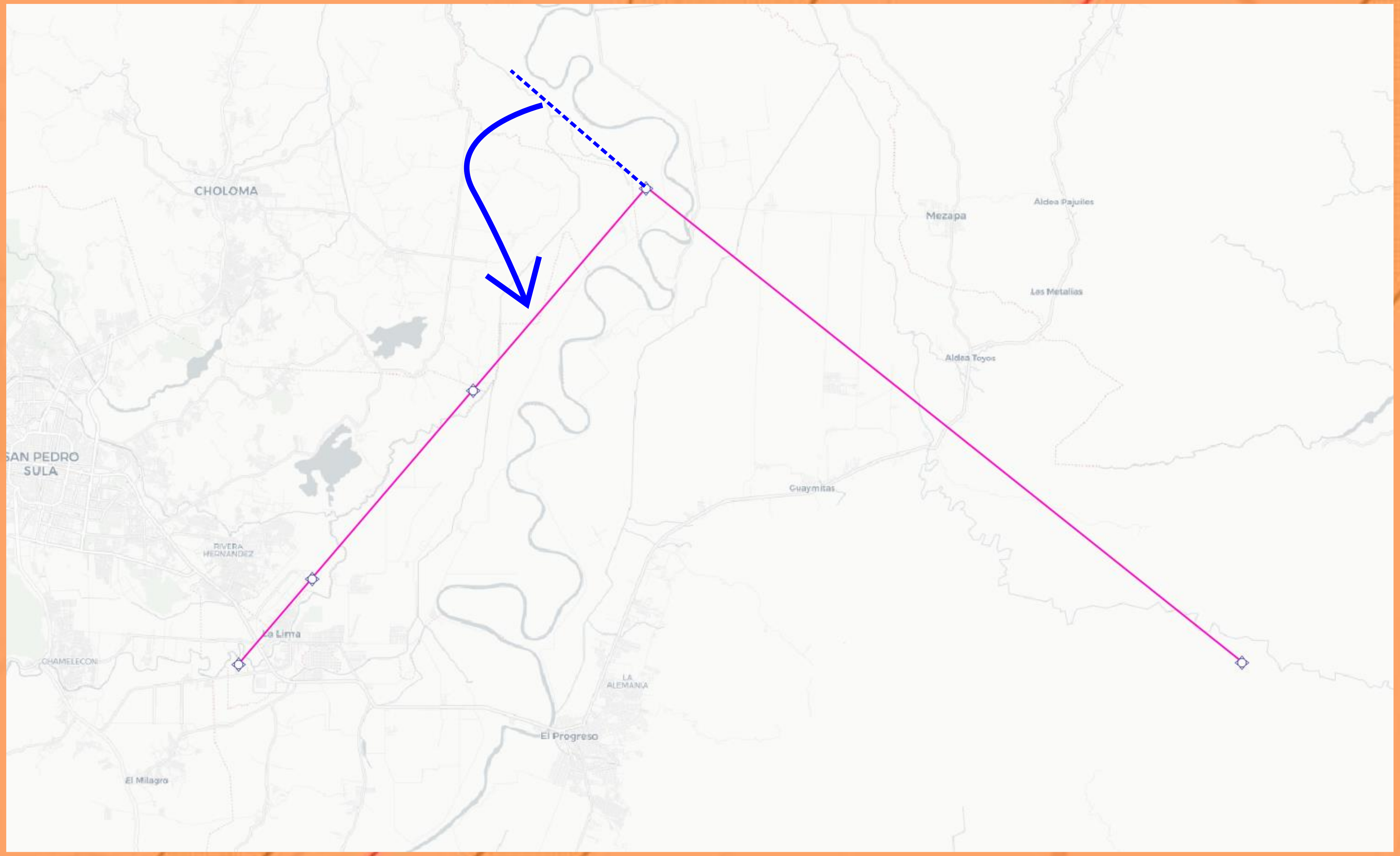
Alignment

This is the angle we have in between one segment and the next segment.

What we are looking for is that a maximum angle of turn is never to be exceeded and this will depend on the type of procedure and in what part of the procedure the aircraft is



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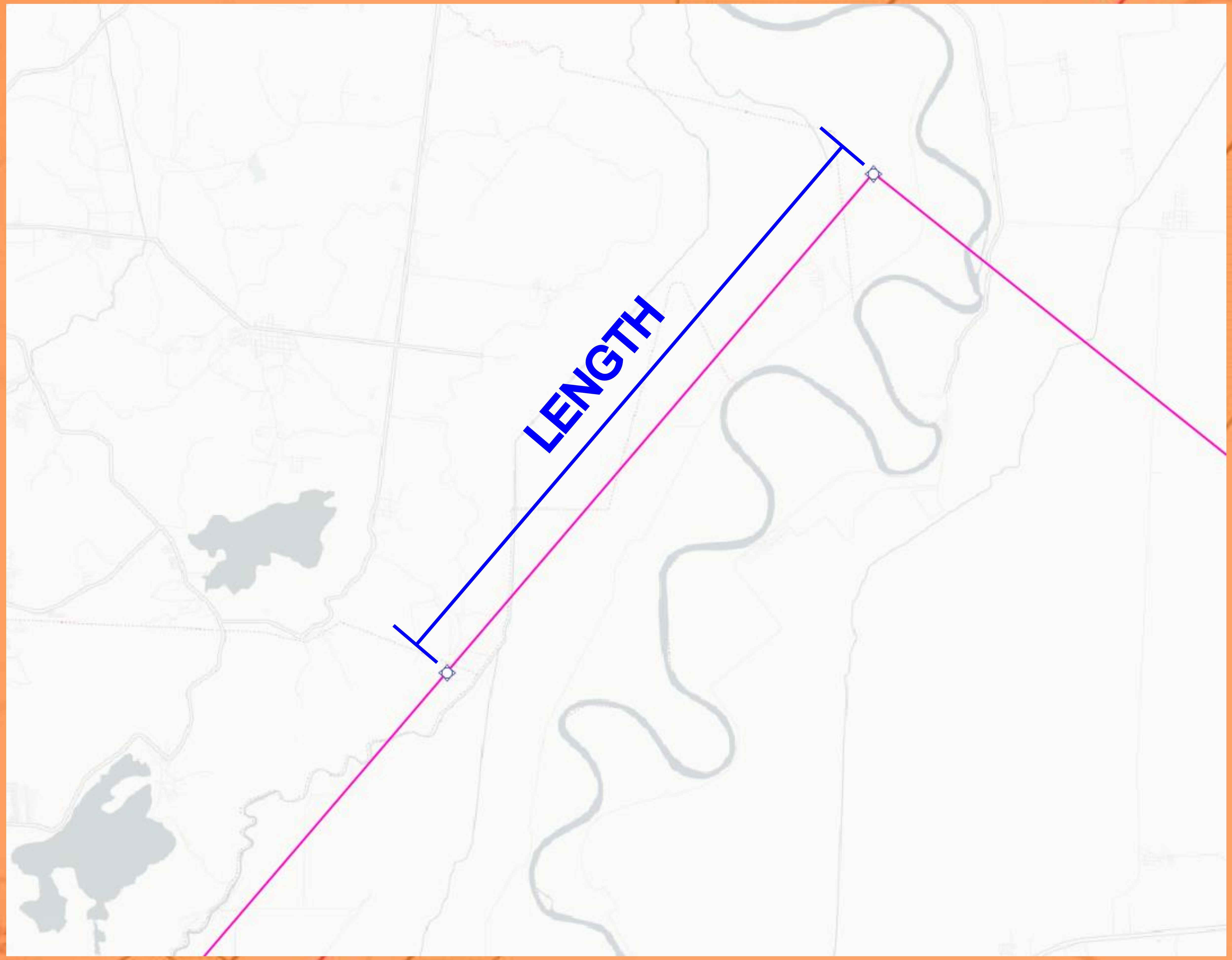
Length

Each track that we design has a distance between the start and the end points.

The length needs to accommodate any descent that we require, and it is influenced by the gradient if its is acceptable or not and in PBN the minimum stabilization distance is also a factor



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Gradient

The change in altitude divided by the overall length or the rise over run is one of those criteria that will make us iterate over the length specially in challenging terrain

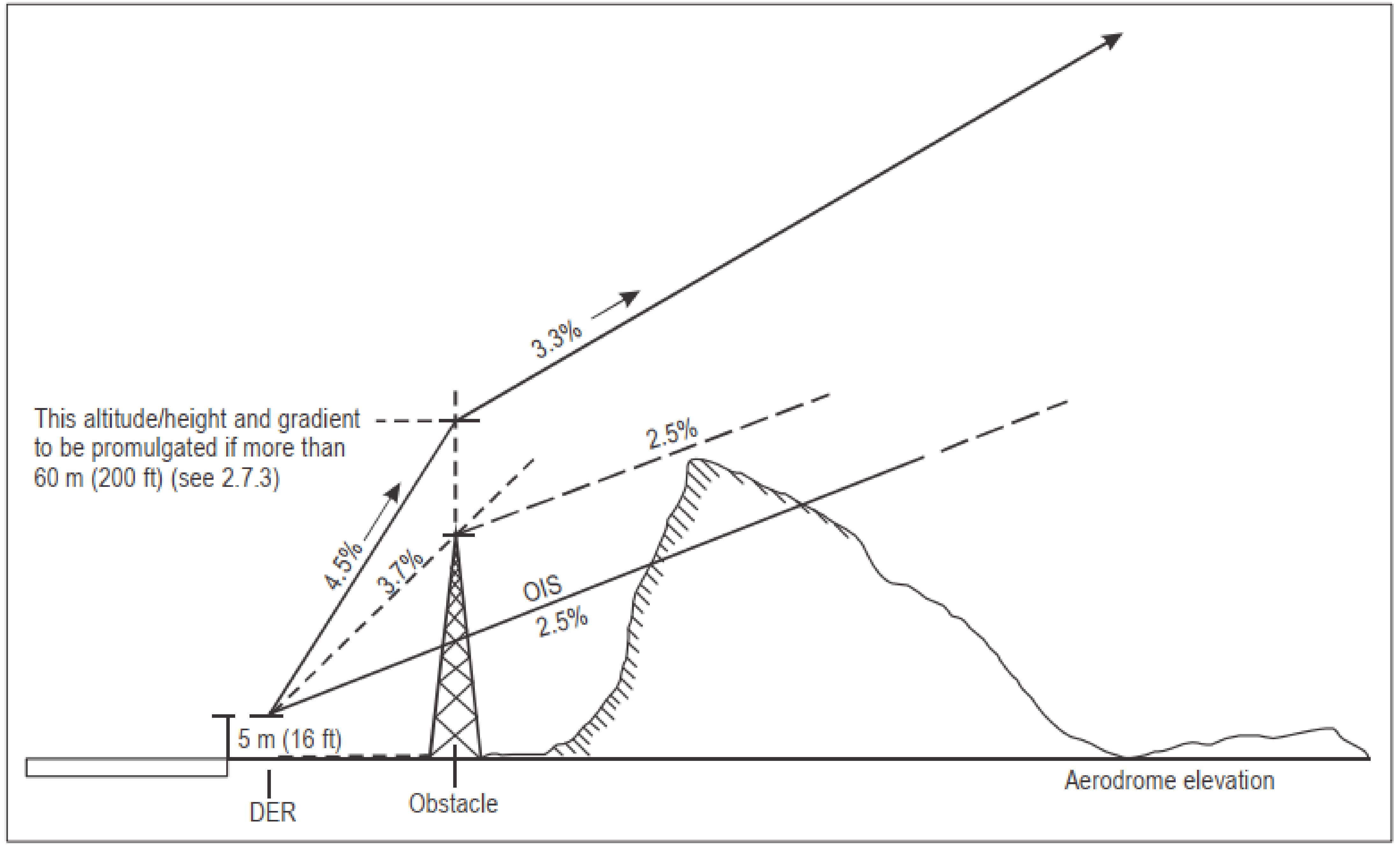

Figure I-3-2-2. Procedure design gradient

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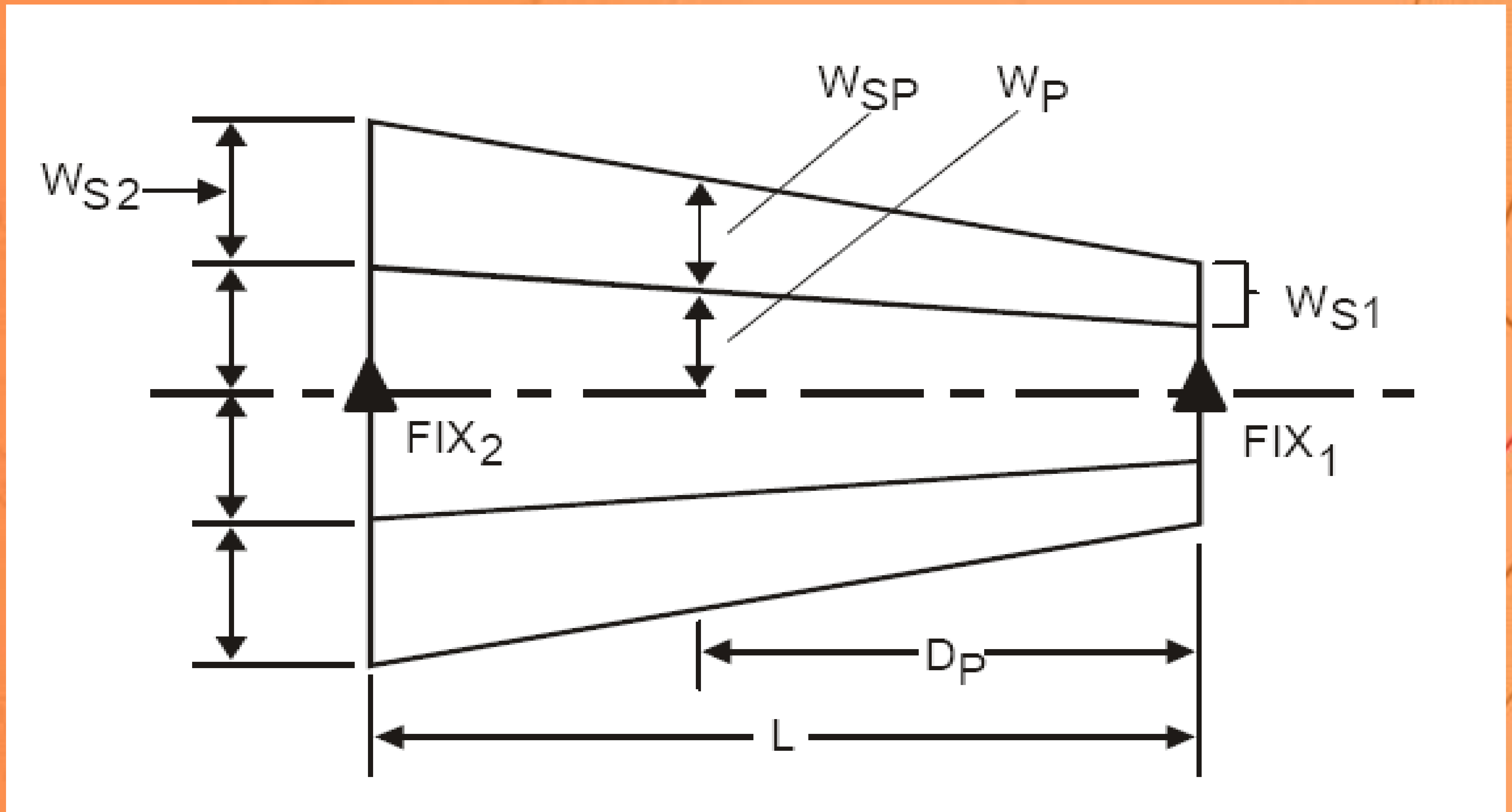
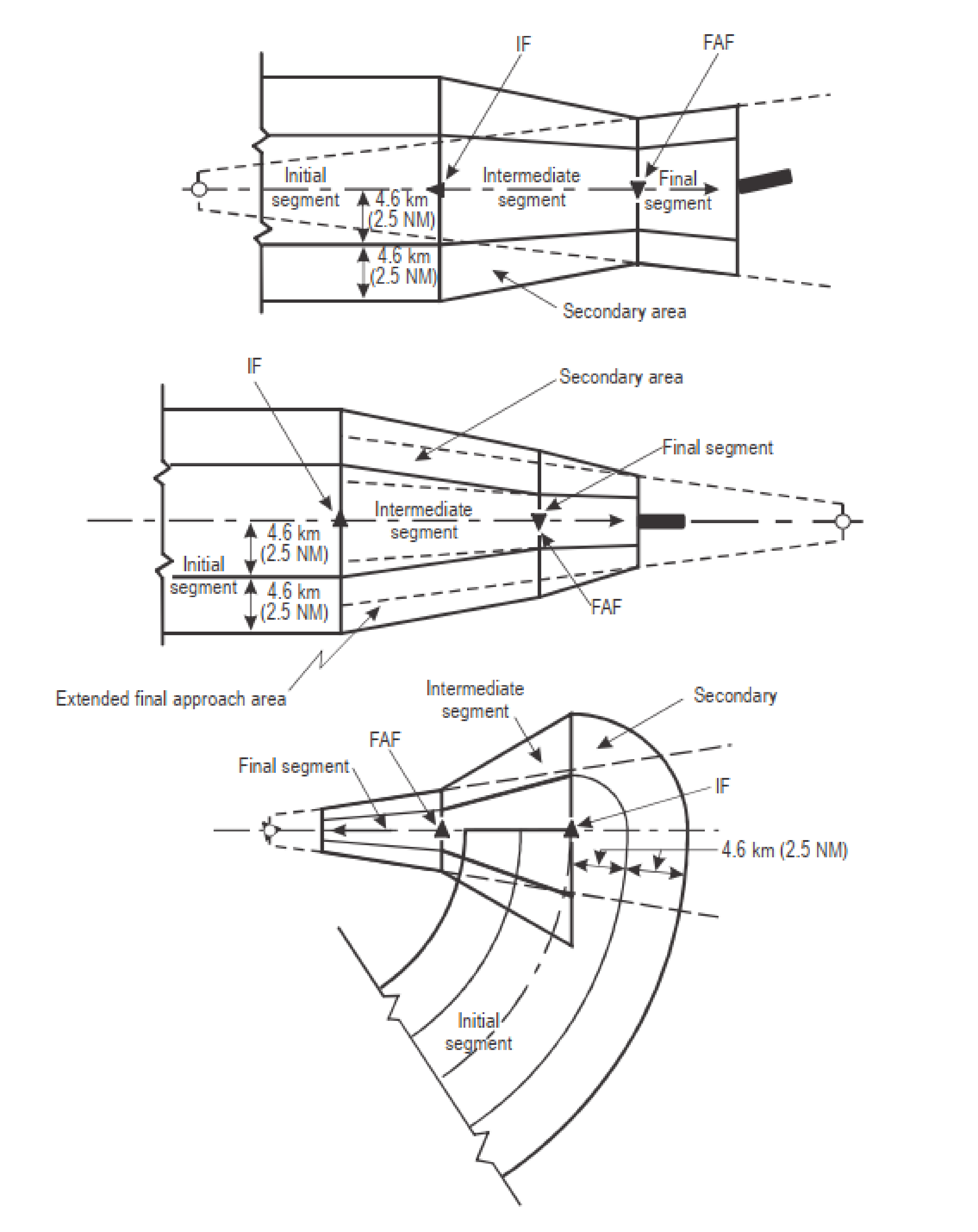
Area



$$W_{sp} = W_{s1} + D_p/L\ (W_{s2} - W_{s1})$$

Area



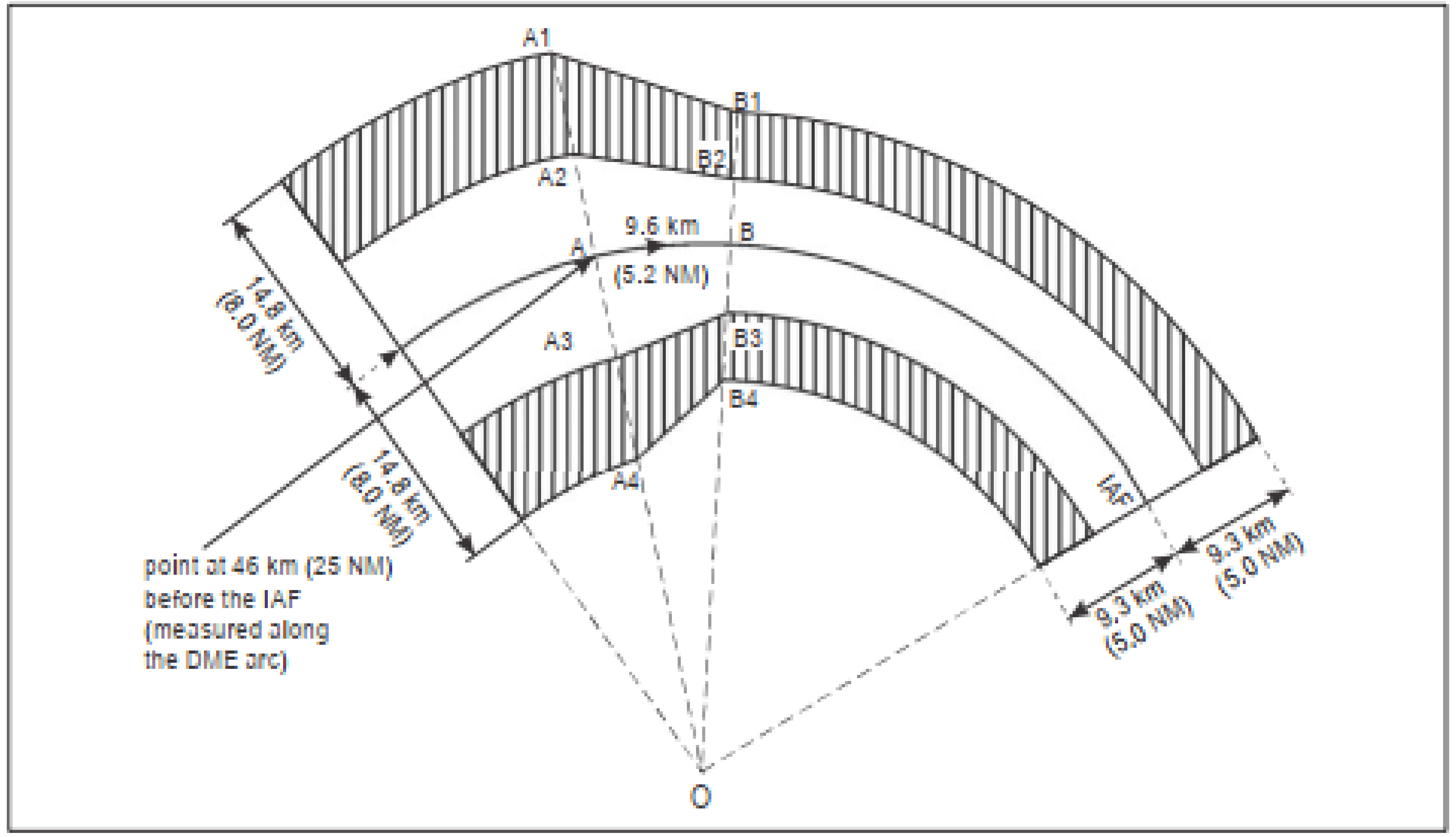


Figure I-4-2-3. DME arc — length of the arrival segment greater than or equal to 46 km (25 NM)

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Minimum Obstacle Clearance (MOC)

The MOC is the minimum obstacle clearance will provide the vertical distance that we need to apply that will allow to fly the aircraft safely over terrain or obstacles.

There are different variables that were factored in when determining the values that are applicable that included the terrain, aircraft characteristics and pilot ability, so the values that are mentions in PANS OPS are to be considered the minimum which included also considerations for communications (COM) and aerodromes and ground aids (AGA) so they can't be reduced further in a safe way.

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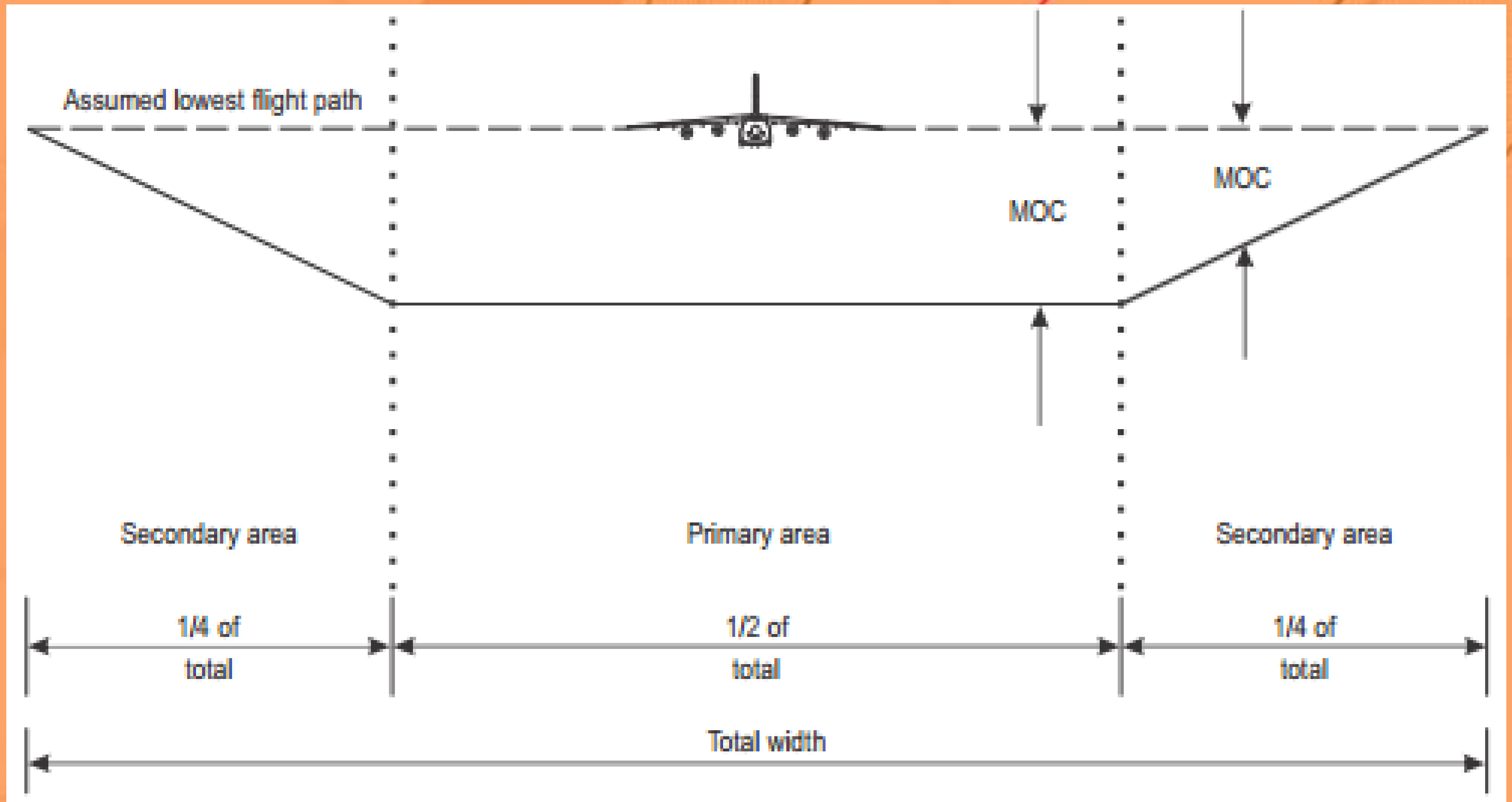
In the primary areas the **full** MOC is to be applied while in the secondary areas we will reduce this value linearly from 100% at the edge of the primary area to 0% at the outer edge of the secondary area, always considering perpendicular to the nominal track.



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Sample MOC applied per segment

Initial	300m
Intermediate	150m
NPA Final Approach	75m (with FAF) / 90m (without a FAF)
Missed Approach	
- Initial Phase	Same as Final Approach*
- Intermediate Phase	30m
- Final Phase	50m

*** There is an exception if the extension of the intermediate missed approach surface backwards requires less clearance**

Mountainous Area

What is it?

How do we calculate it?

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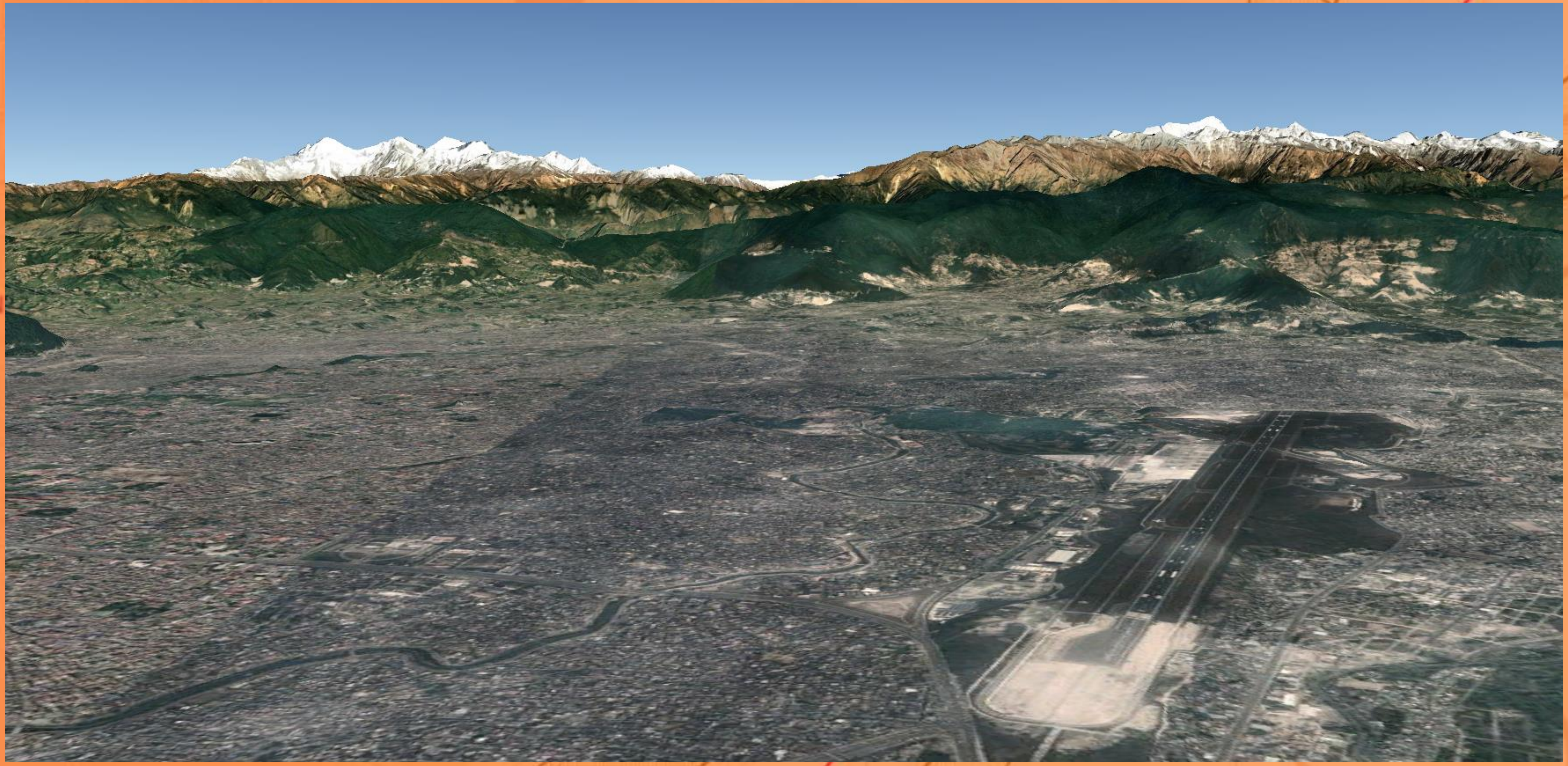
What do we have to do in mountainous areas?

In mountainous areas due to the nature of the terrain there are considerations like altimeter error and pilot control issues due to bad weather (winds over 20KTS) that will require the increase of the MOC by as much as 100%



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Mountainous Terrain

1.3.2 MOC in mountainous areas

1.3.2.1 In mountainous areas, the MOC shall be increased, depending on variation in terrain elevation as shown in the table below. The MOC in the buffer area is half the value of the primary area MOC (see Figure II-3-1-1).

Elevation	*MOC*
Between 900 m (3 000 ft) and 1 500 m (5 000 ft)	450 m (1 476 ft)
Greater than 1 500 m (5 000 ft)	600 m (1 969 ft)

1.3.2.2 Mountainous areas shall be identified by the State and promulgated in the State Aeronautical Information Publication (AIP), section GEN 3.3.5, "Minimum flight altitude".

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What exactly are mountainous areas?

Mountainous area

An area of changing terrain profile where the changes of terrain elevation exceed 900 m (3 000 ft) within a distance of 18.5 km (10.0 NM).

The increased used and areas of applicability is to be published in the Aeronautical Information Publication (AIP) GEN 3.3.5 Minimum Flight Altitude

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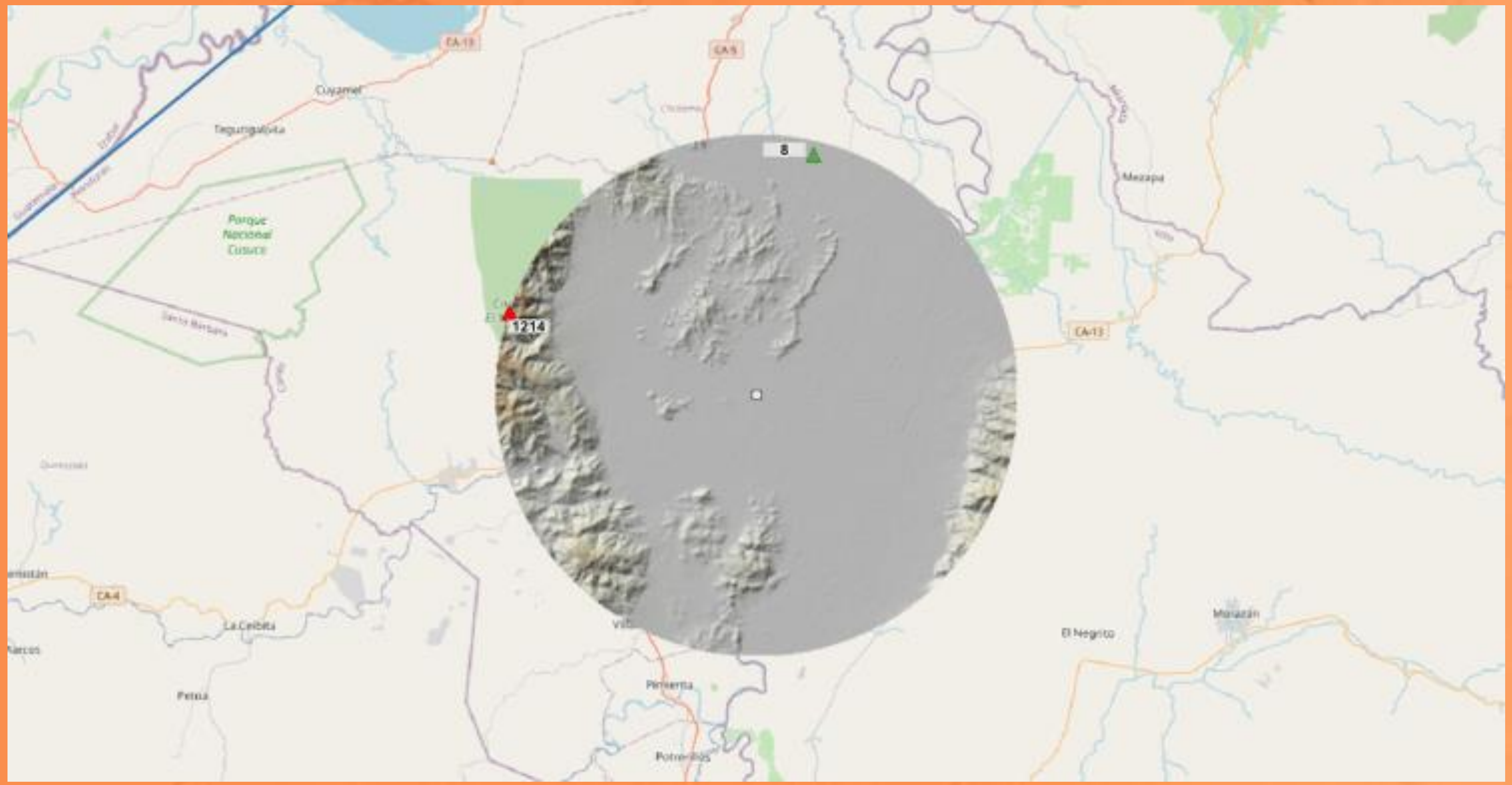
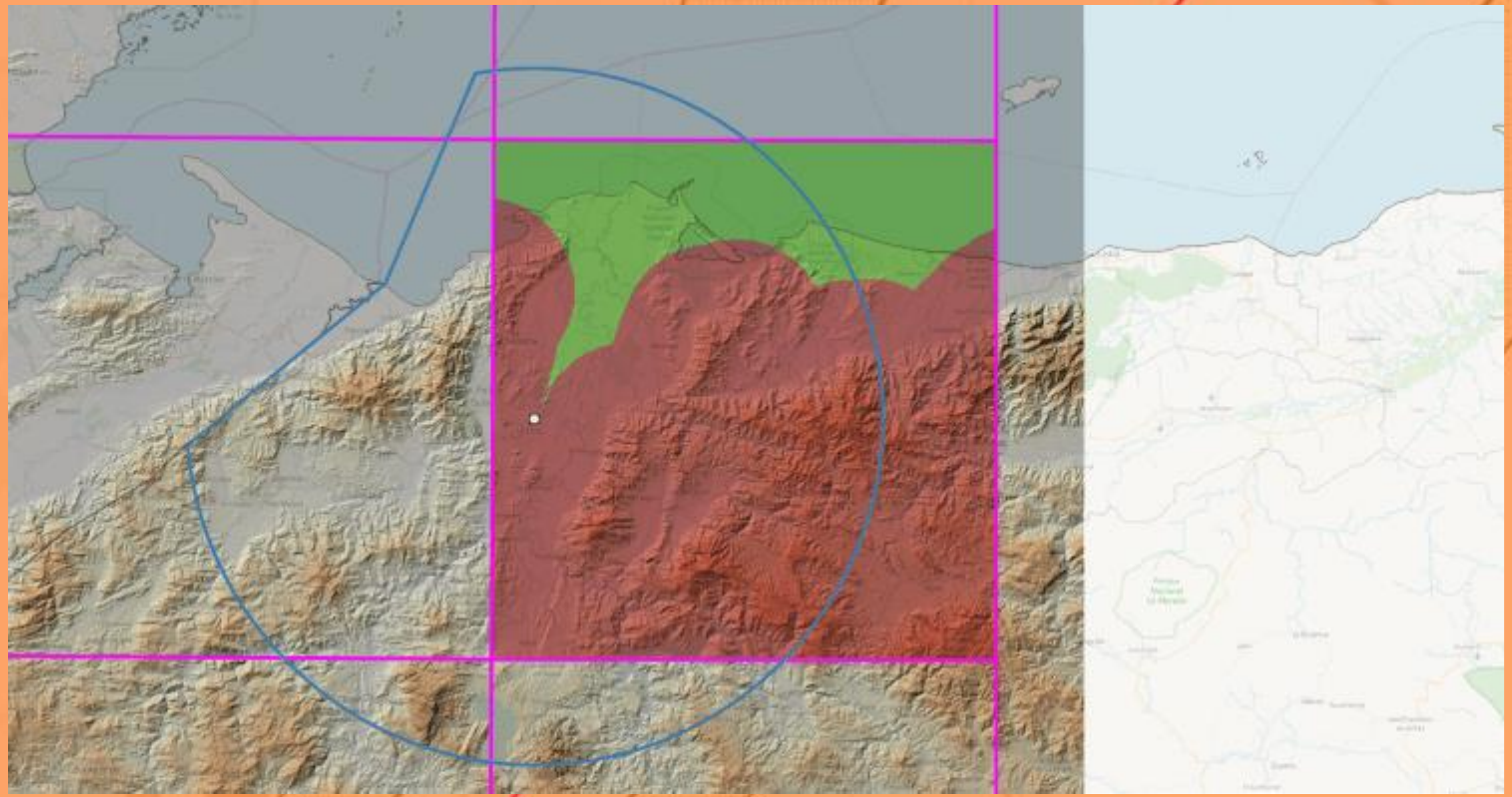
Mountainous Area Calculation





https://flyght7.com/pans-ops-mountainous-area-calculation-for-instrument-flight-procedure-design-ifpd-part-i/

https://flyght7.com/pans-ops-mountainous-area-calculation-for-instrument-flight-procedure-design-ifpd-part-ii/

What about turns?

Wind Spirals

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Turn Protection

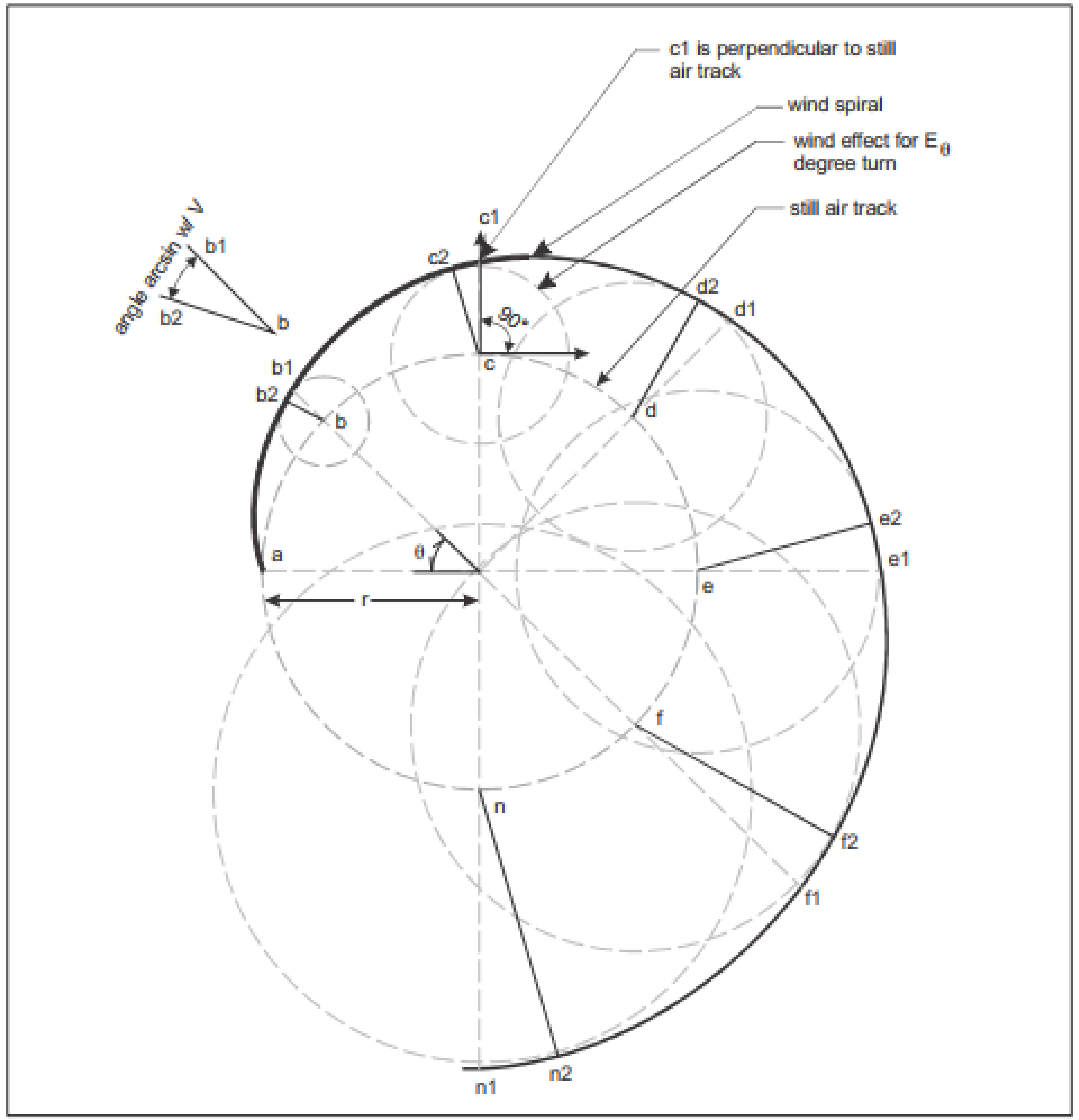

Figure I-2-3-4. Wind spiral

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ILS example

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LNAV construction

Quick demo

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Nassau
Lyford Cay
Lynden Pindling International Airport
Lake Killarney
New Providence

Open Discussion

Questions & Answers

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