NATS

RNAV Flight Procedures Design

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Workshop for General Aviation
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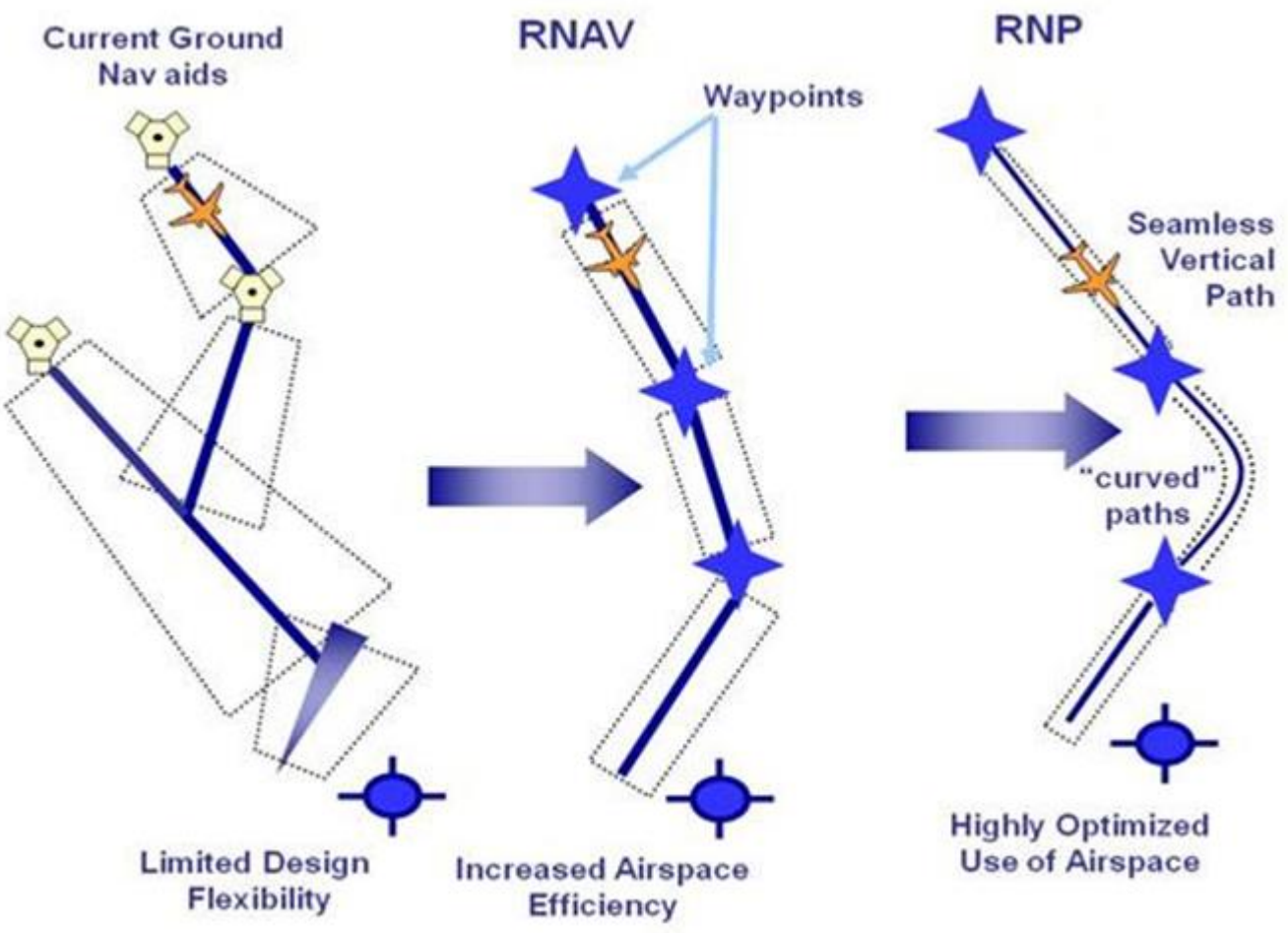
Contents

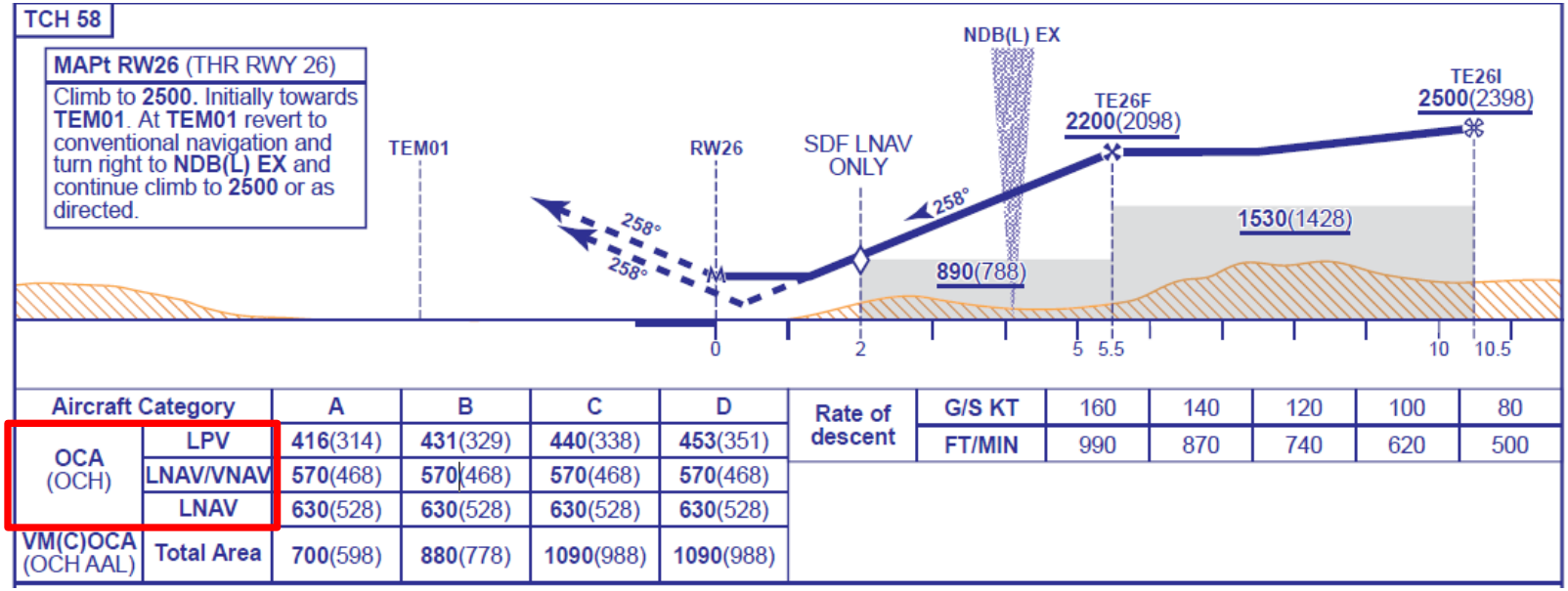
Throughout the world, there are many airports, suitable for transport aircraft operation, that do not have available ground navaids. On these airports, RNAV approach procedures could be established and published without the need for large investments.

Procedure Design – RNAV Path Types



The minima are expressed as:

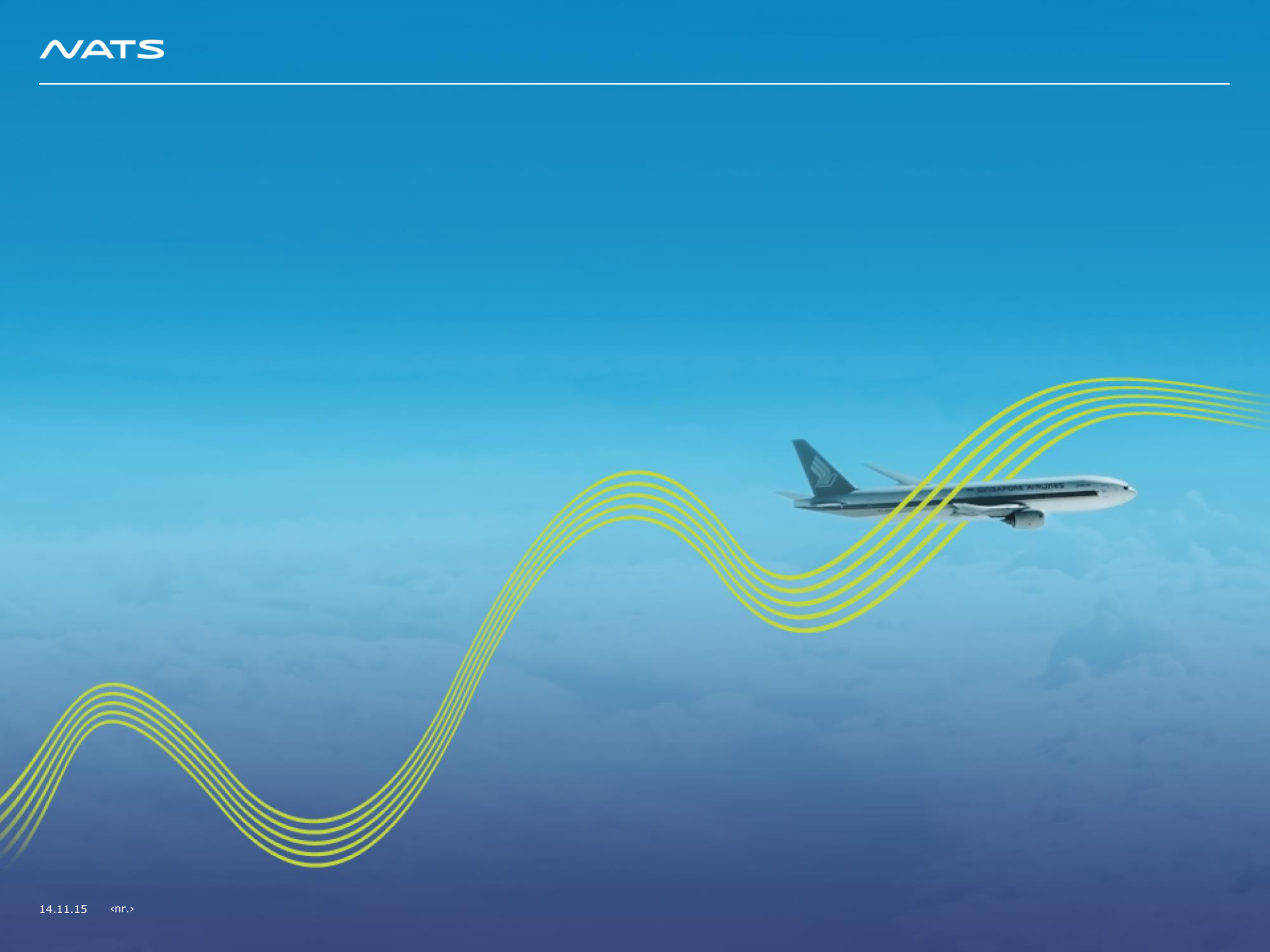
DA(H) and RVR (or vis) for LNAV/VNAV
MDA(H) and RVR (or vis) for LNAV only.



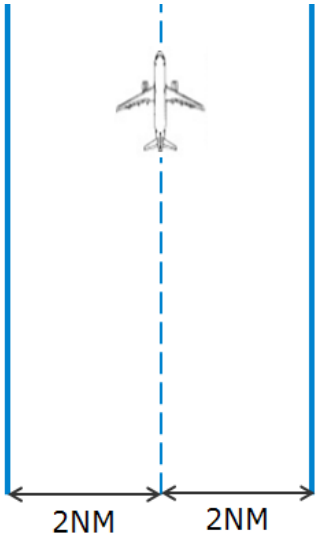
Aircraft Category		A	B	C	D
OCA (OCH)	LPV	416(314)	431(329)	440(338)	453(351)
	LNAV/VNAV	570(468)	570(468)	570(468)	570(468)
	LNAV	630(528)	630(528)	630(528)	630(528)
VM(C)OCA (OCH AAL)	Total Area	700(598)	880(778)	1090(988)	1090(988)

Rate of descent	G/S KT	160	140	120	100	80
	FT/MIN	990	870	740	620	500

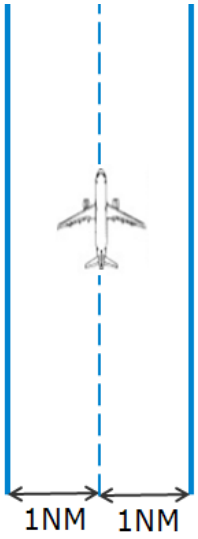
CATEGORY	A	B	C	D
LPV DA	856-1 258 (300-1)			
LNAV/VNAV DA	1125-1¾ 527 (600-1¾)			
LNAV MDA	1060-1 462 (500-1)		1060-1¼ 462 (500-1¼)	1060-1½ 462 (500-1½)
CIRCLING	1160-1 554 (600-1)		1160-1½ 554 (600-1½)	1320-2¼ 714 (800-2¼)



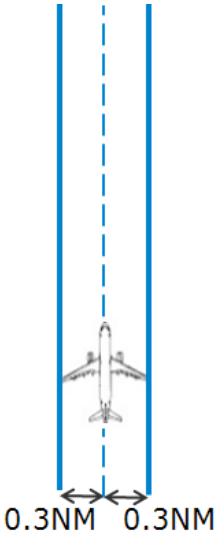
Design principles – factors taken into consideration



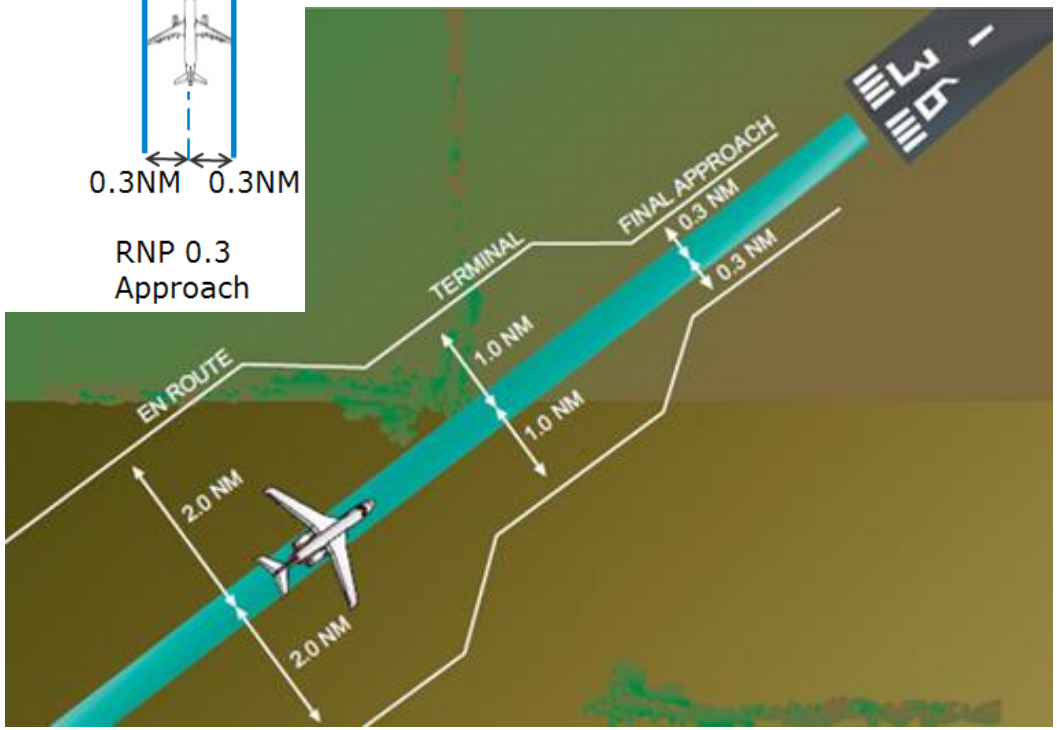
RNP 2.0
Enroute



RNP 1.0
Terminal

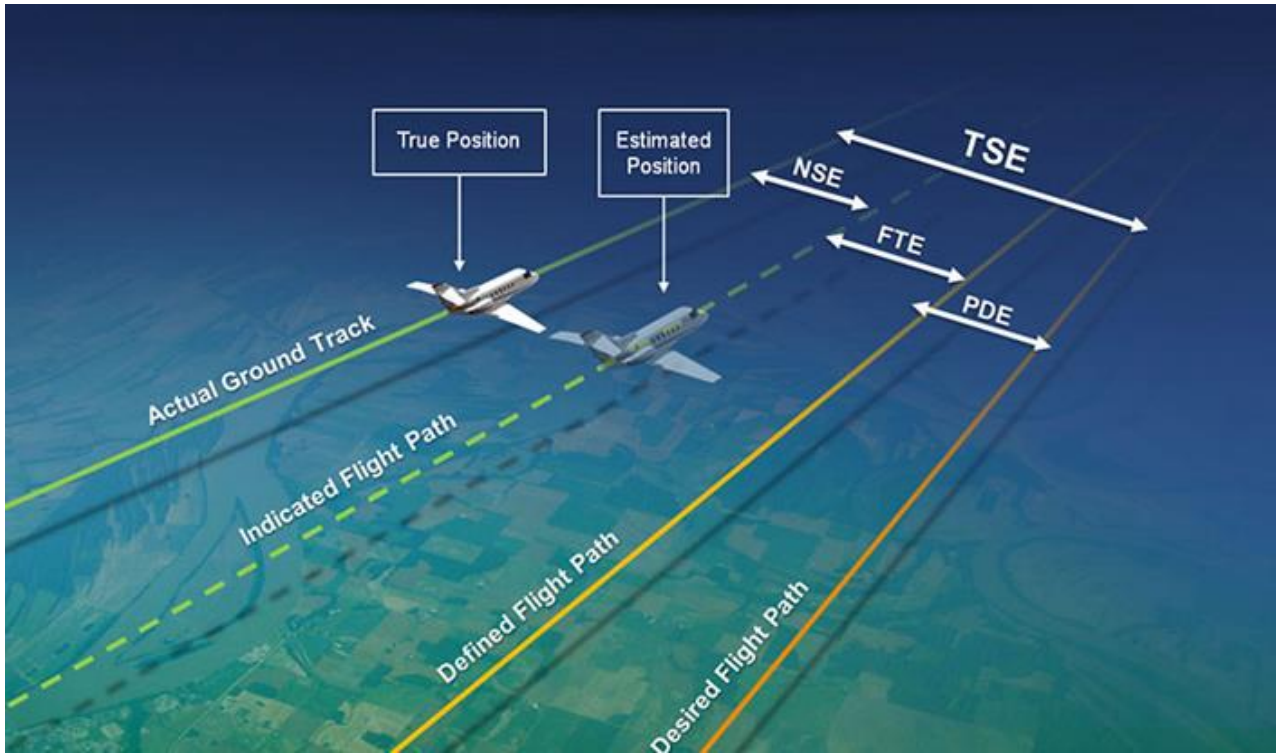


RNP 0.3
Approach

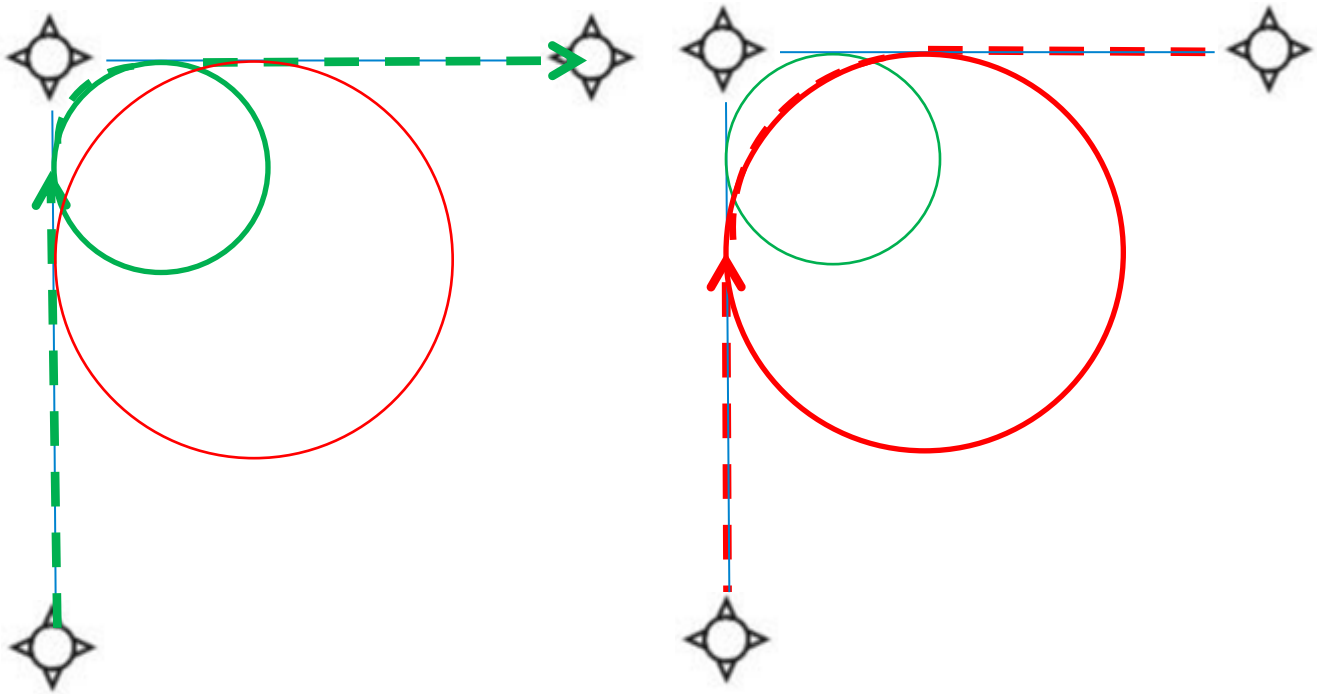


Design principles – factors taken into consideration

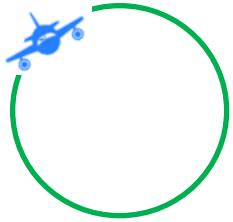
Monitoring and Alerting



Waypoints – impact of Turn Performance



- Speed
- Bank angle



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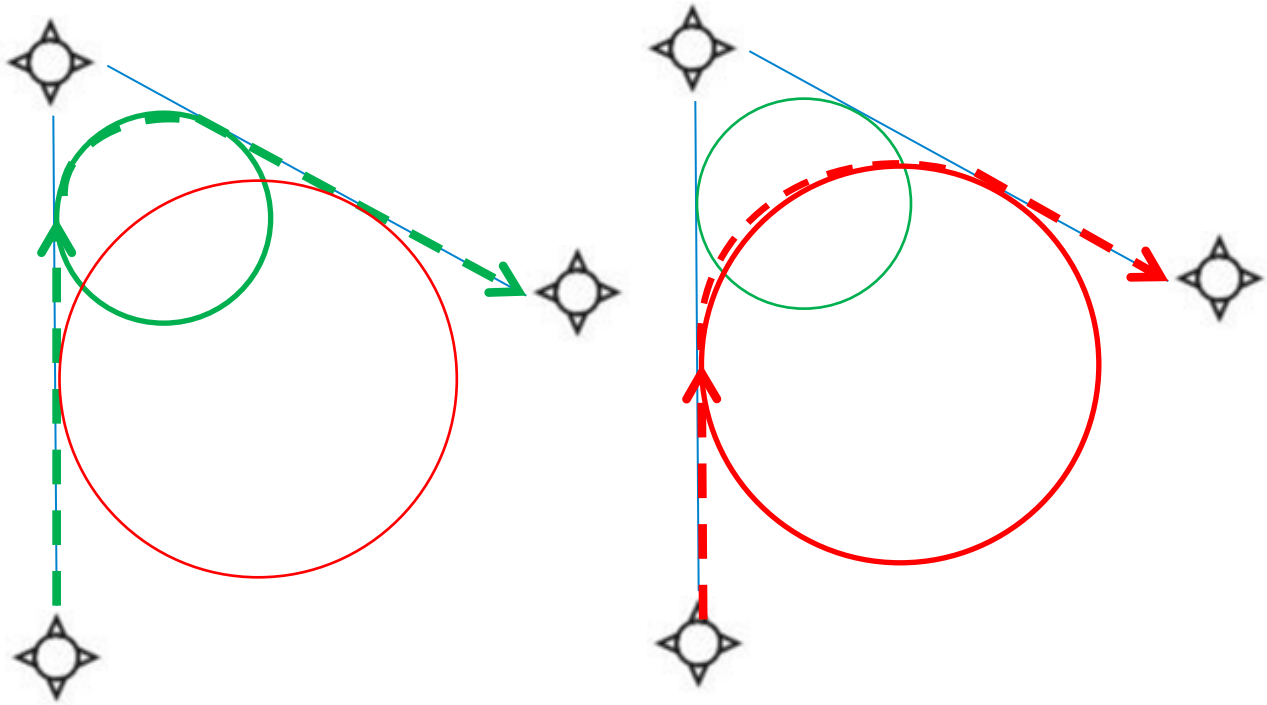
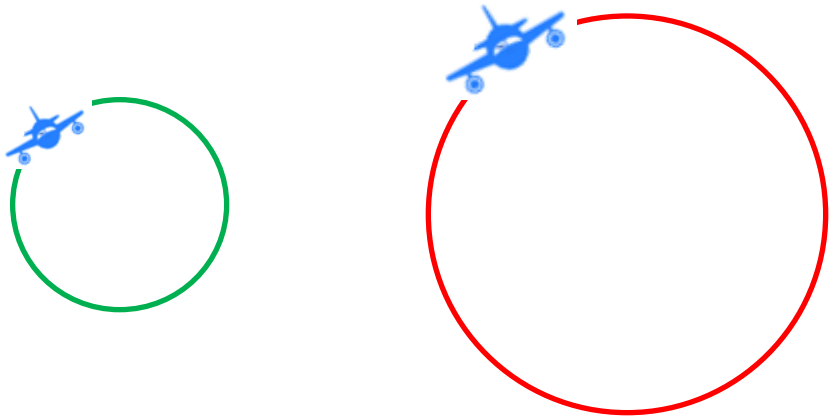
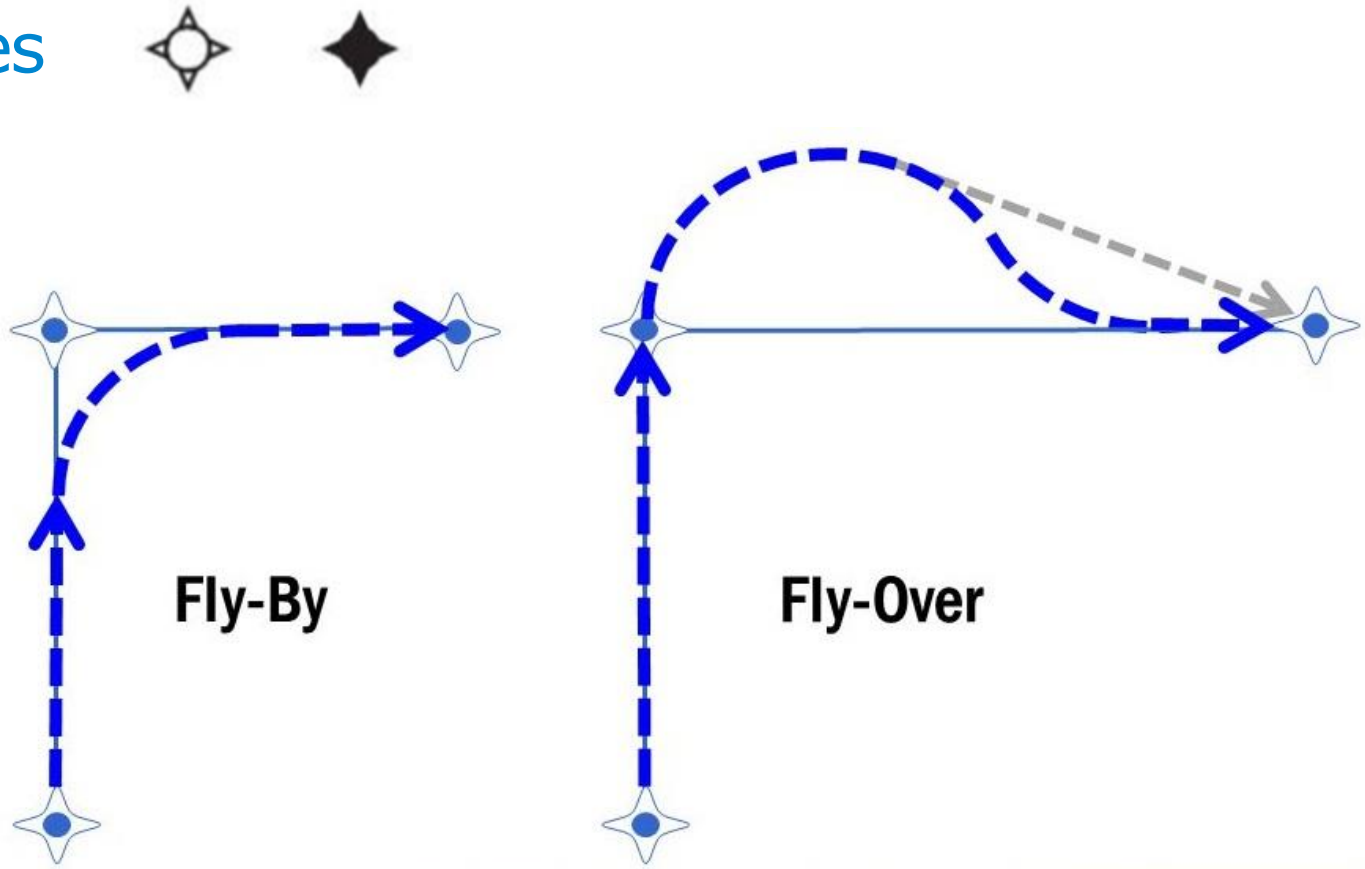


- Speed
- Bank angle

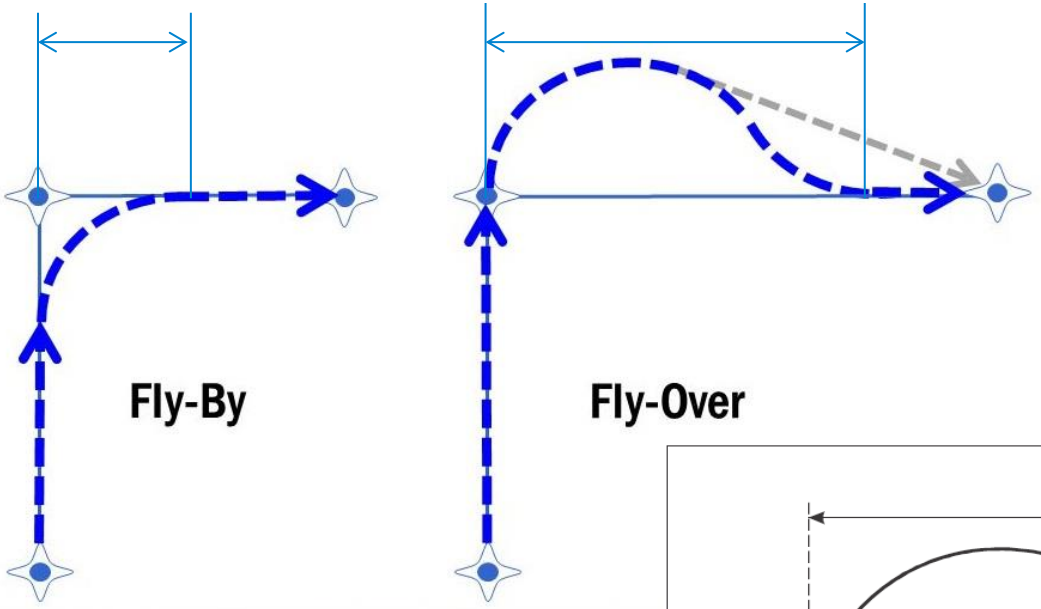


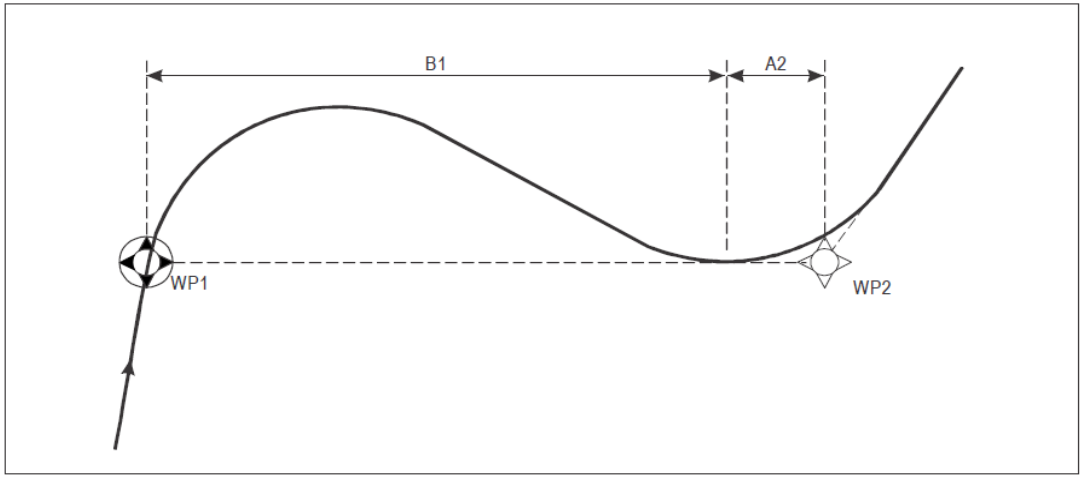
Waypoints types



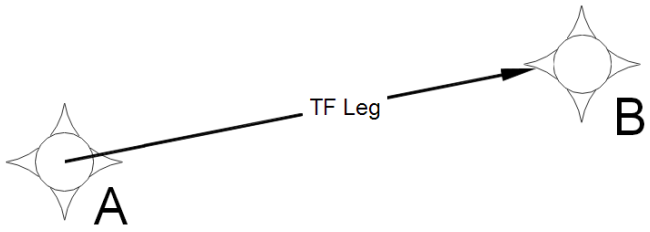
Minimum segment length

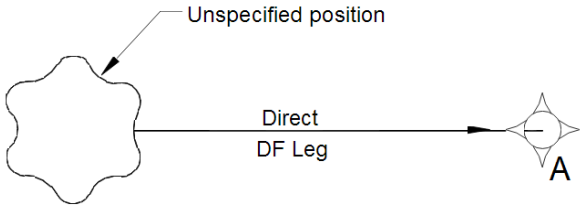
Minimum stabilisation distance

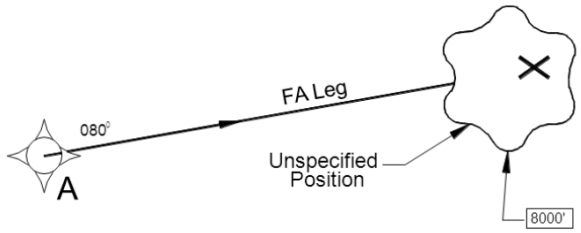




Path Terminators

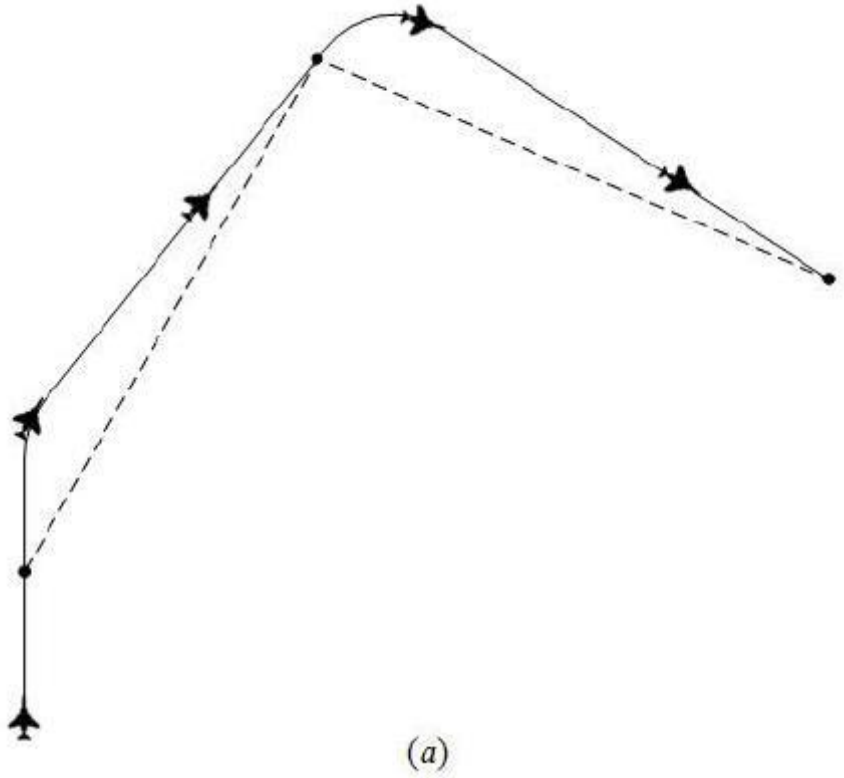


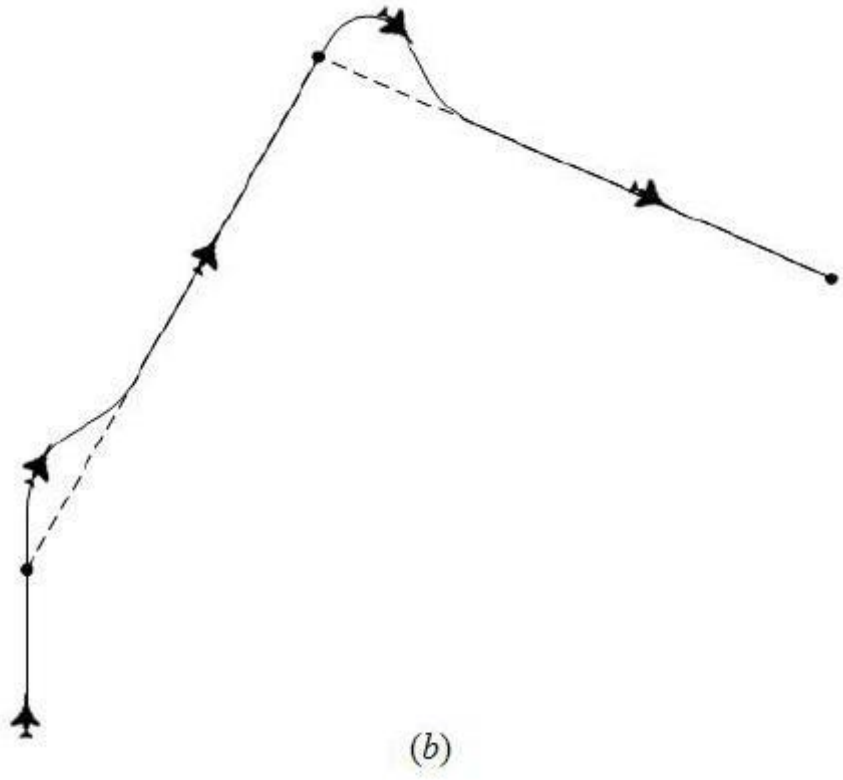




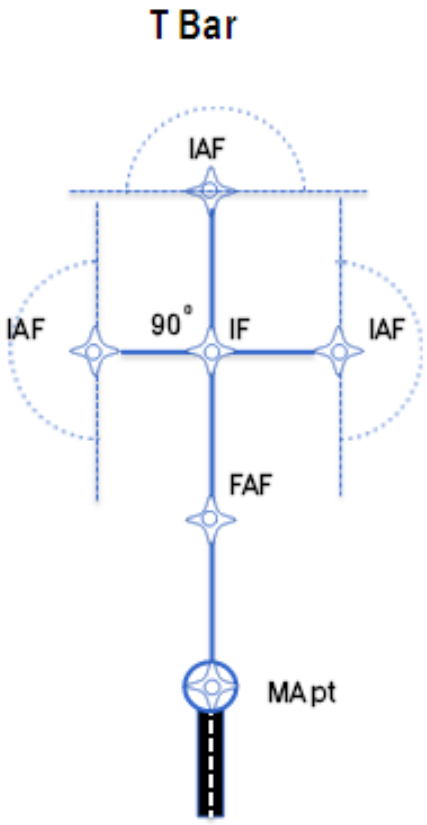
Path		Terminator	
Constant DME arc	A	A	Altitude
Course to	C	C	Distance
Direct Track	D	D	DME distance
Course from a fix to	F	F	Fix
Holding pattern	H	I	Next leg
Initial	I	M	Manual termination
Constant radius	R	R	Radial termination
Track between	T		
Heading to	V		

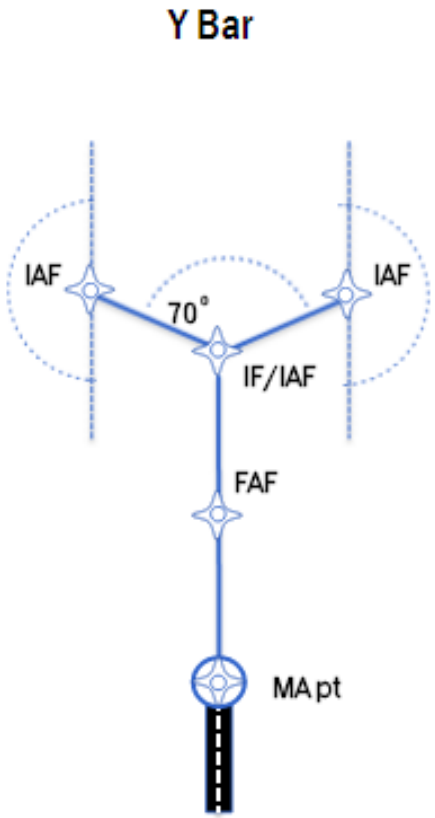
Coding differences

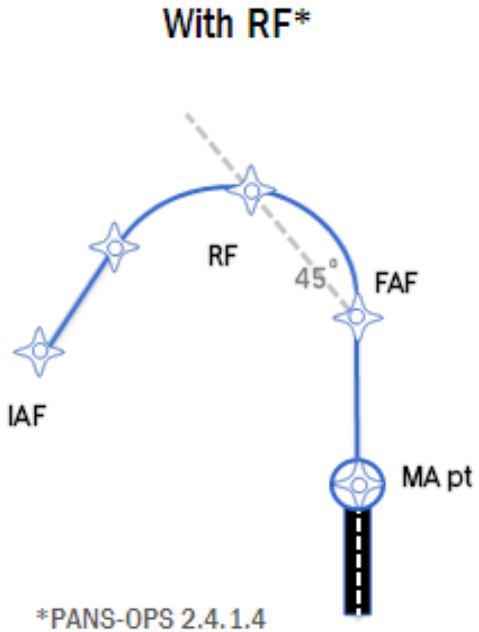




RNAV and RNP Approaches

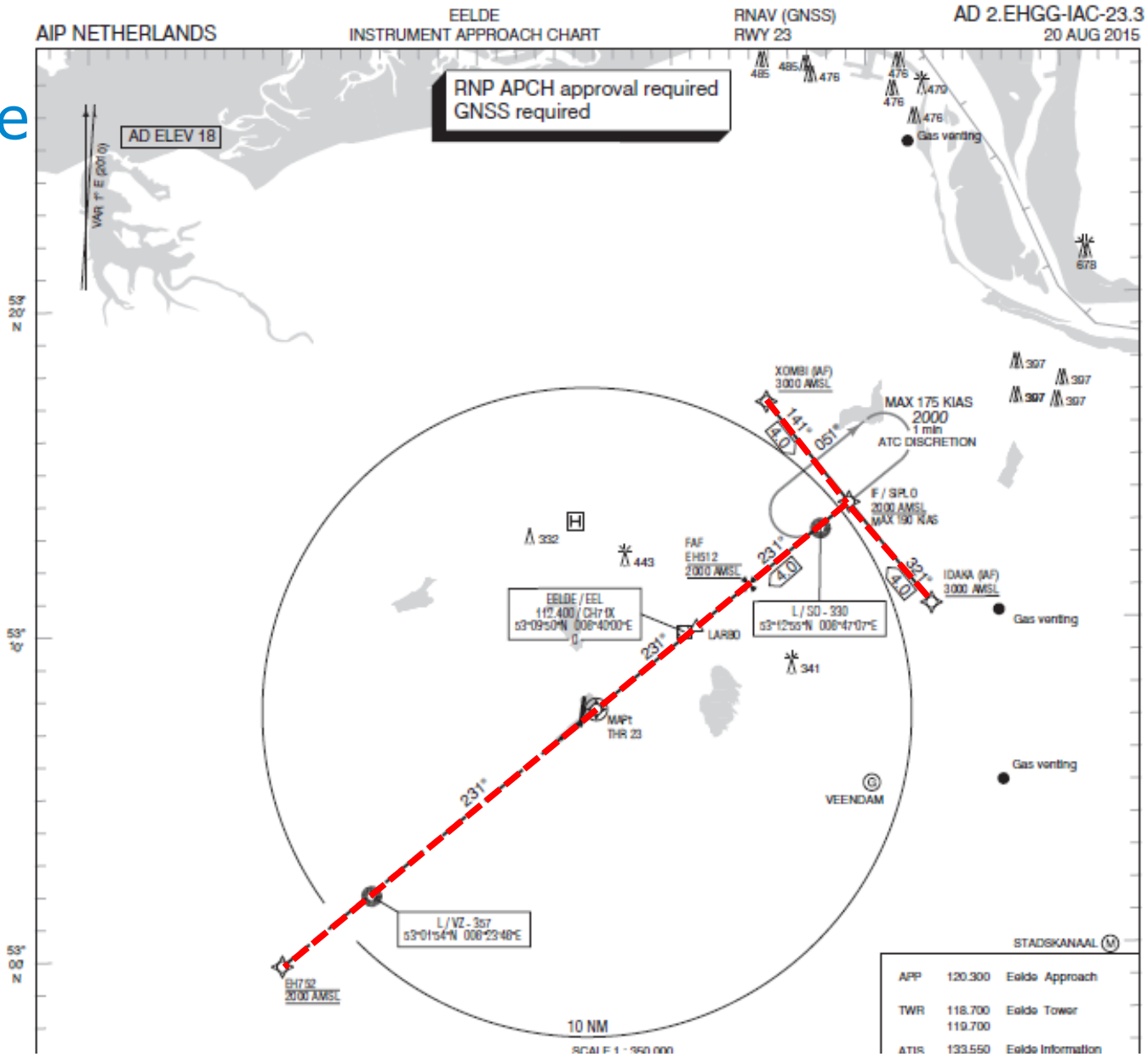




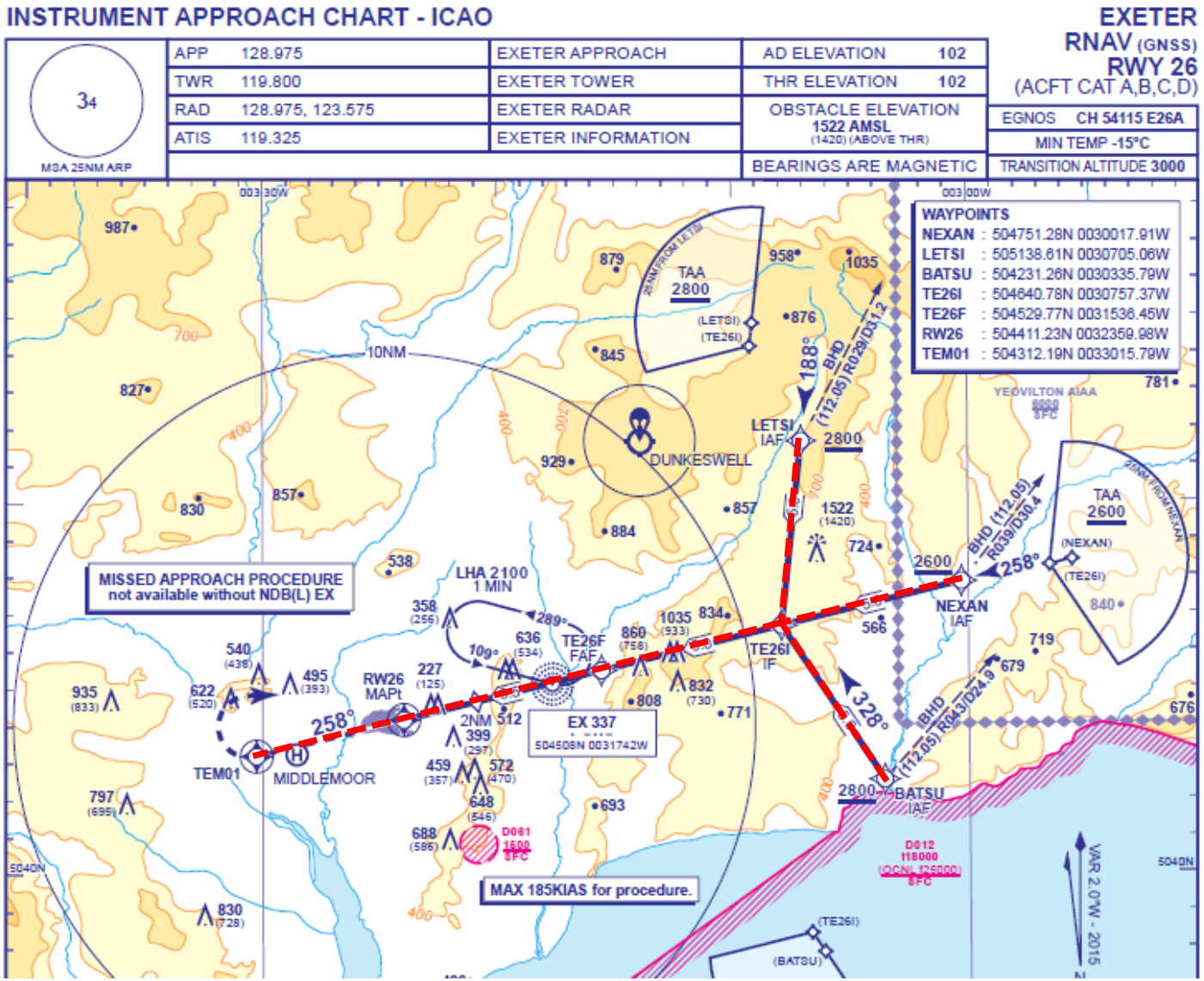


*PANS-OPS 2.4.1.4
13 NOV 2014

Example


AIP NETHERLANDS
EELDE
INSTRUMENT APPROACH CHART
RNAV (GNSS)
RWY 23
AD 2.EHGG-IAC-23.3
20 AUG 2015
RNP APCH approval required
GNSS required
AD ELEV 18
VAR 1° E (2015)
XOMBI (IAF)
3000 AMSL
MAX 175 KIAS
2000
1 min
ATC DISCRETION
F / SR.O
2000 AMSL
MAX 190 KIAS
IDAKA (IAF)
3000 AMSL
FAF
EH512
2000 AMSL
EELDE / EEL
112.400 / CH71X
53°09'50"N 006°40'00"E
LAR80
L / SO - 330
53°12'55"N 006°47'07"E
MAPt
THR 23
L / VZ - 357
53°01'54"N 006°23'48"E
EH752
2000 AMSL
VEENDAM
Gas venting
Gas venting
Gas venting
STADSKANAAL
APP 120.300 Eelde Approach
TWR 118.700 Eelde Tower
119.700
ATIS 133.550 Eelde Information
10 NM
141°
051°
231°
4.0
53° 20' N
53° 10'
53° 00' N

Example


INSTRUMENT APPROACH CHART - ICAO
EXETER
RNAV (GNSS)
RWY 26
(ACFT CAT A,B,C,D)
34
MSA 25NM ARP
APP 128.975
EXETER APPROACH
TWR 119.800
EXETER TOWER
RAD 128.975, 123.575
EXETER RADAR
ATIS 119.325
EXETER INFORMATION
AD ELEVATION 102
THR ELEVATION 102
OBSTACLE ELEVATION
1522 AMSL
(1420) (ABOVE THR)
BEARINGS ARE MAGNETIC
EGNOS CH 54115 E26A
MIN TEMP -15°C
TRANSITION ALTITUDE 3000
WAYPOINTS
NEXAN : 504751.28N 0030017.91W
LETSI : 505138.61N 0030705.06W
BATSU : 504231.26N 0030335.79W
TE26I : 504640.78N 0030757.37W
TE26F : 504529.77N 0031536.45W
RW26 : 504411.23N 0032359.98W
TEM01 : 504312.19N 0033015.79W
MISSED APPROACH PROCEDURE
not available without NDB(L) EX
LHA 2100
1 MIN
EX 337
504508N 0031742W
MAX 185KIAS for procedure.
TAA
2800
(LETSI)
(TE26I)
25NM FROM LETSI
TAA
2600
(NEXAN)
(TE26I)
25NM FROM NEXAN
LETSI
IAF
NEXAN
IAF
BATSU
IAF
TE26I
IF
TE26F
FAF
RW26
MAPt
TEM01
MIDDLEMOOR
DUNKESWELL
YEOVILTON AIAA
10NM
BHD (112.05) R029/D31.2
BHD (112.05) R039/D30.4
IBHD (112.05) R043/D24.9
188°
258°
328°
289°
109°
2NM
VAR 2.0°W - 2015

Design requirements

RNAV approach design should:

- Be based on accurate source data, recently surveyed, using WGS 84 geodetic system;
- Meet the criteria of ICAO PANS OPS (or TERPS);
- Be performed by personnel knowledgeable in instrument approach procedure design;
- Consider aircraft capable of RNP 0.3 using GPS navigation;
- Evaluate the GPS availability considering the ground environment;
- Take into account the aircraft category that is envisaged to operate on the airport.

Questions?


EZS1537
300 -
25
AUA356U
240 -
29
BEL5CH
240 -
29
DLH73A
340 -
37
HZSKI
330 -
KLM1622 >
380 -
25 EHAM
DLH05X *
340 -
31
GWI588
240 -
39
GOGSK
320 -
25
DLH2VY *
340 -
25
TUI94D
LOT336
340 -
DAL8962
060 ↑ 245
32 RAPIX