PBN Procedure Design Course 2026

ICAO APAC FPP

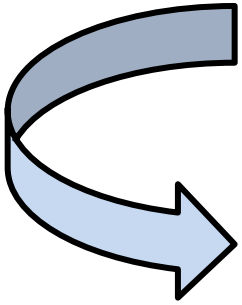
Beijing,China

(7-25/Sep/2026)

RNAV+ ILS

RNAV ILS Concept

- Today :
  - SBAS coverage is not worldwide and few airport are GBAS equipped
  - Major Airports are ILS equipped
  - Most of commercial aircraft are ILS equipped and RNAV1 capable
  - RNAV trajectory in terminal zone or missed approach improve airspace concept (strategic separation, gain of flying distance and environmental benefit)



  - Take benefit of ILS guidance
  - Take benefit of RNAV flexibility
  - Use RNAV trajectory to mitigate radar failure using trajectory close to real flying one
  - Take benefit of commercial aircraft equipment on major airports

PBN Application for RNAV ILS

  - RNAV or RNP route with only systems capable of navigation accuracy of **1 NM or lower**.
  - RNAV or RNP route shall terminate at an IF located on the LOC course.
  - RNAV/RNP turn construction is applicable for turns within the initial segment and at the IF on the LOC course
- PBN Applications:
  - ARNP (TSE ≤1),
  - RNAV1,
  - RNP1,
  - RNP APCH (for initial, final and missed)

Differences
RNAV ILS / Conventional ILS

N

E

W

- Missed approach OAS limit
- Connection intermediate / OAS
- RNAV guidance in missed approach (lead to different obstacle assessment)

Unchanged

- **Standard conditions**
- **Height Loss**
- **Obstacles classification (approach or missed approach)**
- **Equivalent height if missed approach obstacle**

APPROACH

Transition RNAV to ILS

- Switch from **RNAV** mode to **ILS** mode at **IF**
- Laterally ： capture of LOC
  - When managed mode (system) anticipation is taken by system even with big turn angle at IF
  - For Flight Director flight overshoot risk increase with 2 problems:
    - No Anticipation made due to early LOC mode activation (No RNAV turn)
    - LOC display sensitivity high => very late movement of LOC needle on the display
  - The Intermediate distance shall be long enough to intercept LOC then glide
    - With short distance => Glide interception by above

Initial Segment

- Navigation RNAV
- Racetrack possible
  - Inbound = LOC guidance
  - Protection as holding
- End at IF with IF in the LOC Axis
  - When IF/LOC ≥ 25 NM ⇒ Control flight
  - IF define as Fly By Waypoint (anticipation)
    - Max turn angle : 90°
    - Optimum : 30° (auto-pilot / LOC coupling issue)

Intermediate Segment Lenth

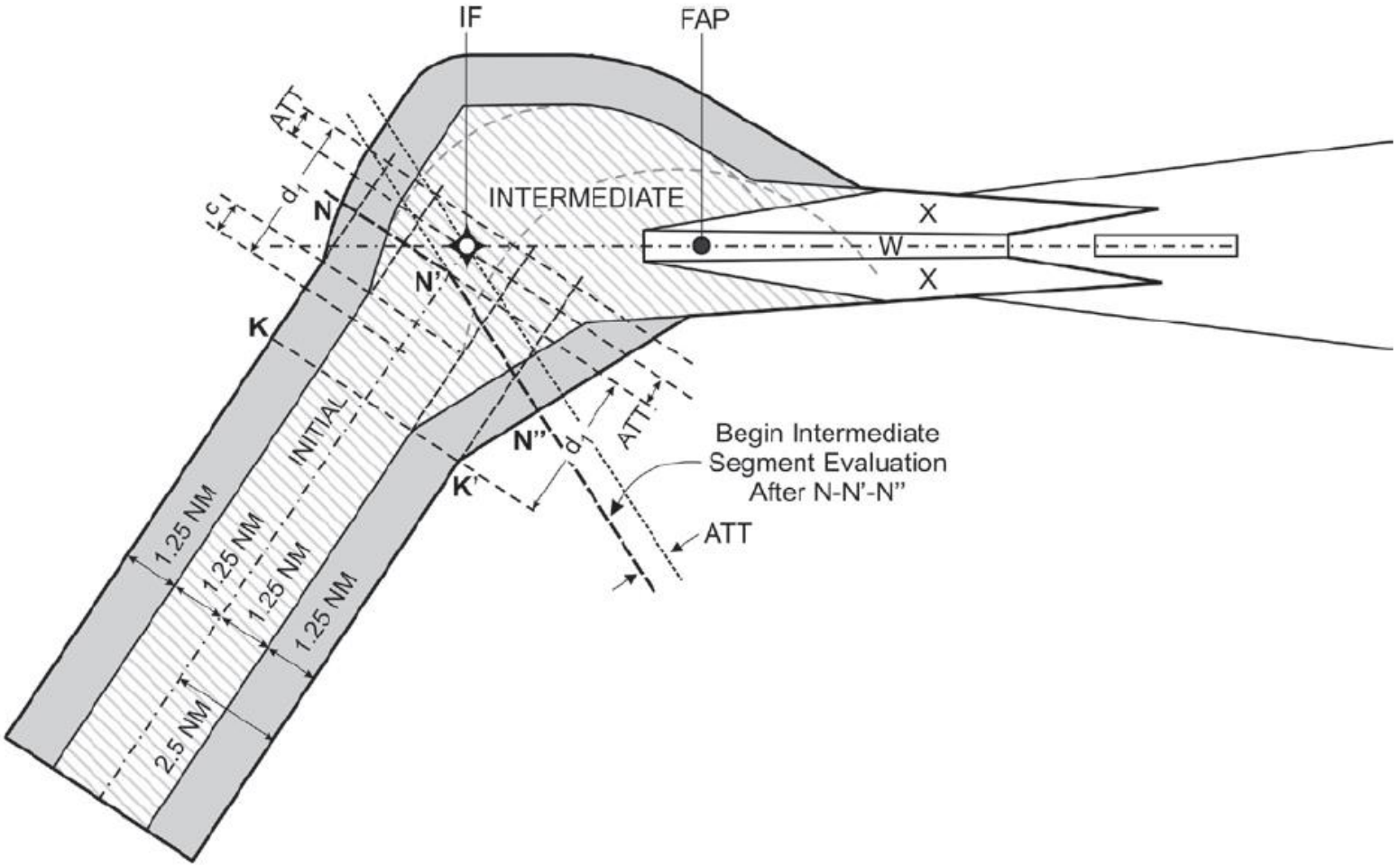
Table II-1-1-1. Minimum distance between localizer and glide path interceptions

Intercept angle with localizer (degrees)	*Cat A/B/H*	*Cat C/D/E*
≤ 0-15 or RF turn to the LOC course	2.8 km (1.5 NM)	2.8 km (1.5 NM)
16 —30	3.7 km (2.0 NM)	3.7 km (2.0 NM)
31 — 60	3.7 km (2.0 NM)	4.6 km (2.5 NM)
61 — 90 or within a racetrack or reversal procedure	3.7 km (2.0 NM)	5.6 km (3.0 NM)

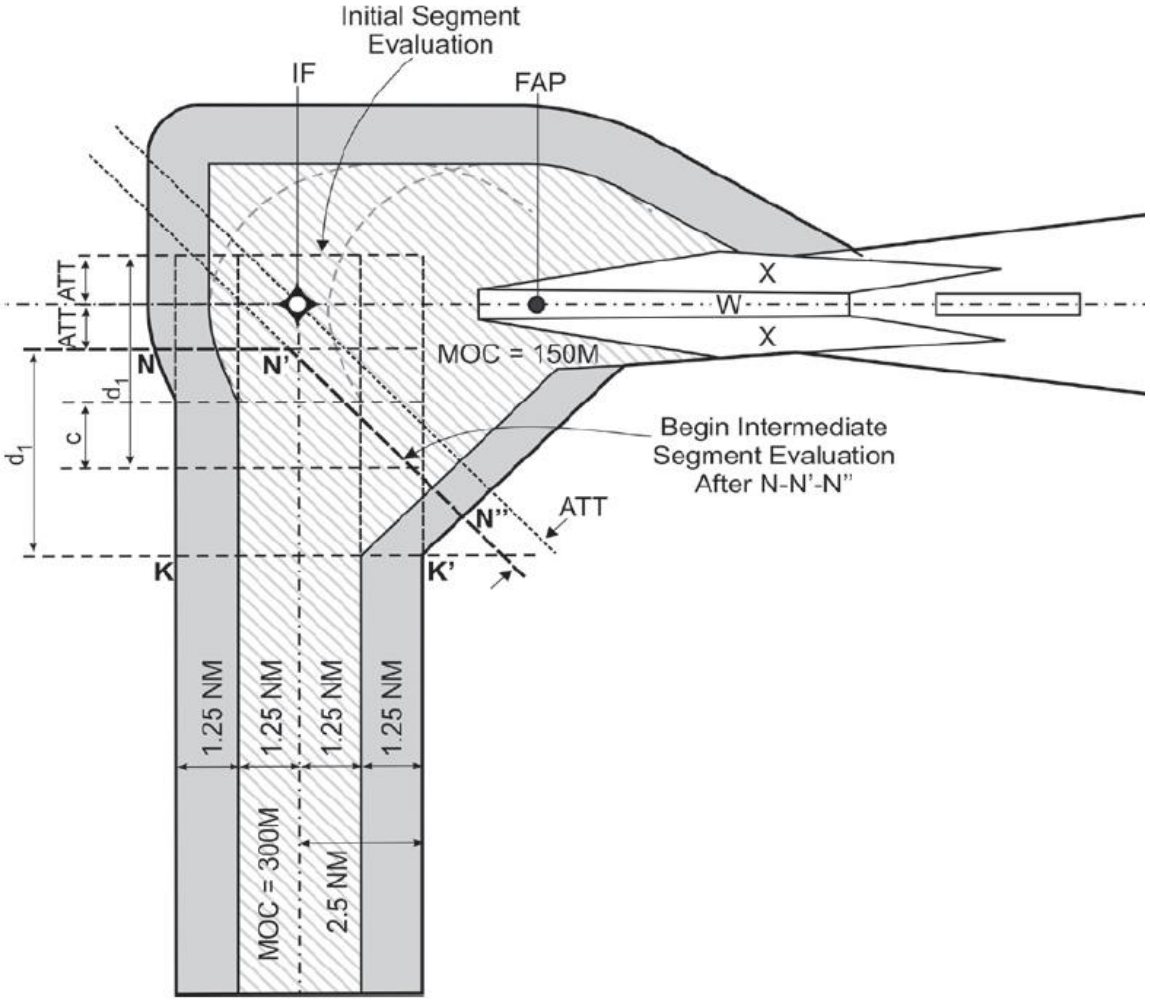
Intermediate Segment Area

- Intermediate area : link between IF and FAF
  - At IF : ½ width RNAV at the end of initial RNAV segment
  - At FAP : width of surface X extension

Turn at IF : 60°


IF
FAP
ATT
d1
c
N
INTERMEDIATE
X
W
X
N'
K
INITIAL
N''
d
ATT
Begin Intermediate
Segment Evaluation
After N-N'-N''
K'
ATT
1.25 NM
1.25 NM
1.25 NM
1.25 NM
2.5 NM

Turn at IF : 90°


Initial Segment Evaluation
IF
FAP
X
W
X
ATT
ATT
N
N'
MOC = 150M
d_1
c
d_1
Begin Intermediate Segment Evaluation After N-N'-N"
N"
ATT
K
K'
1.25 NM
1.25 NM
1.25 NM
1.25 NM
MOC = 300M
2.5 NM

Missed Appraoch

Transition ILS to RNAV in missed approach

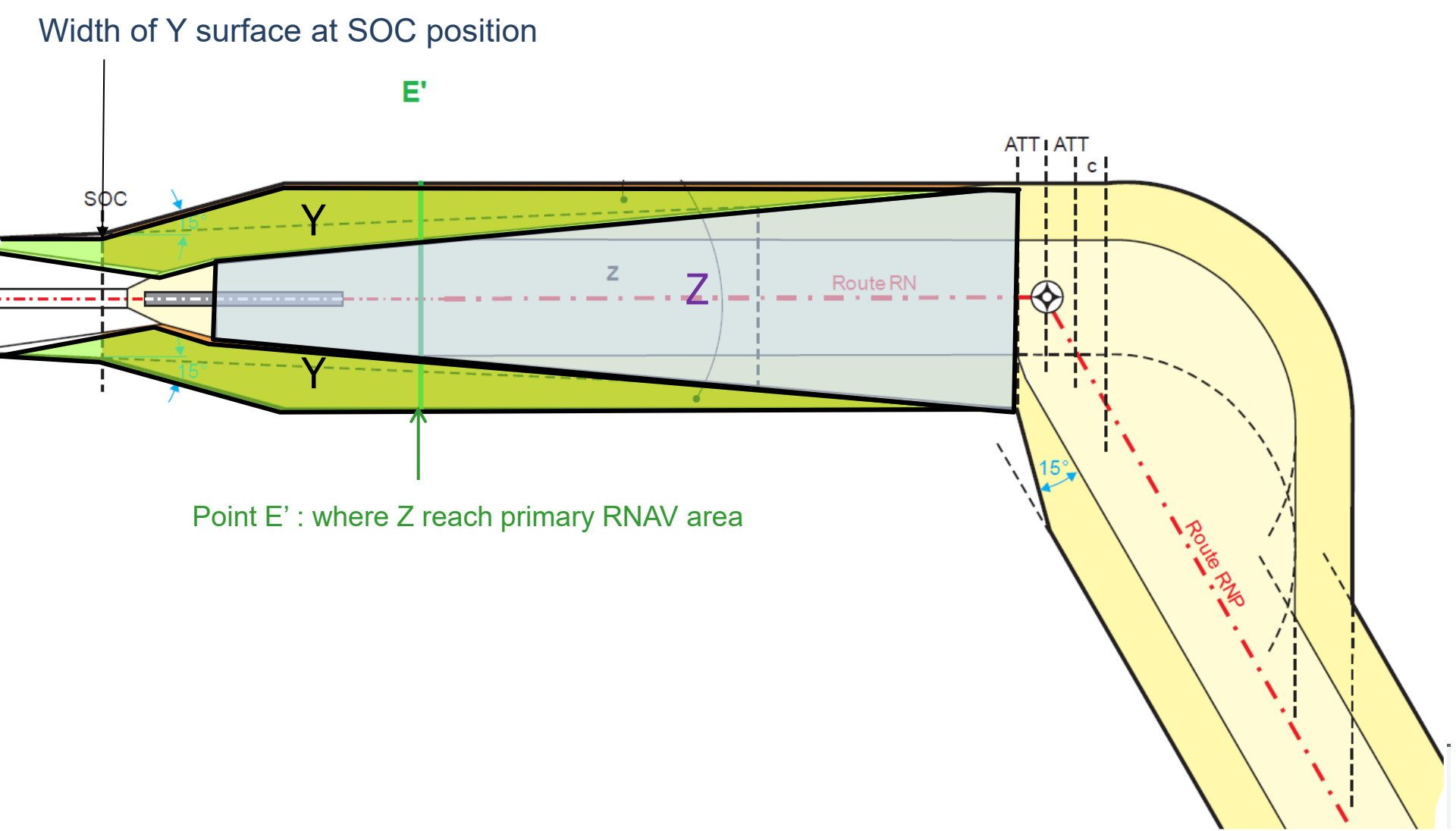
- RNAV or RNP route with only systems capable of navigation accuracy of 1 NM or lower.
- Turn at TP or turn at Altitude possible
- RNAV guidance considered from SOC
- From accurate guidance to less accurate : needle will remain centred even if the aircraft diverge laterally from the trajectory.

Missed approach for ILS to RNAV

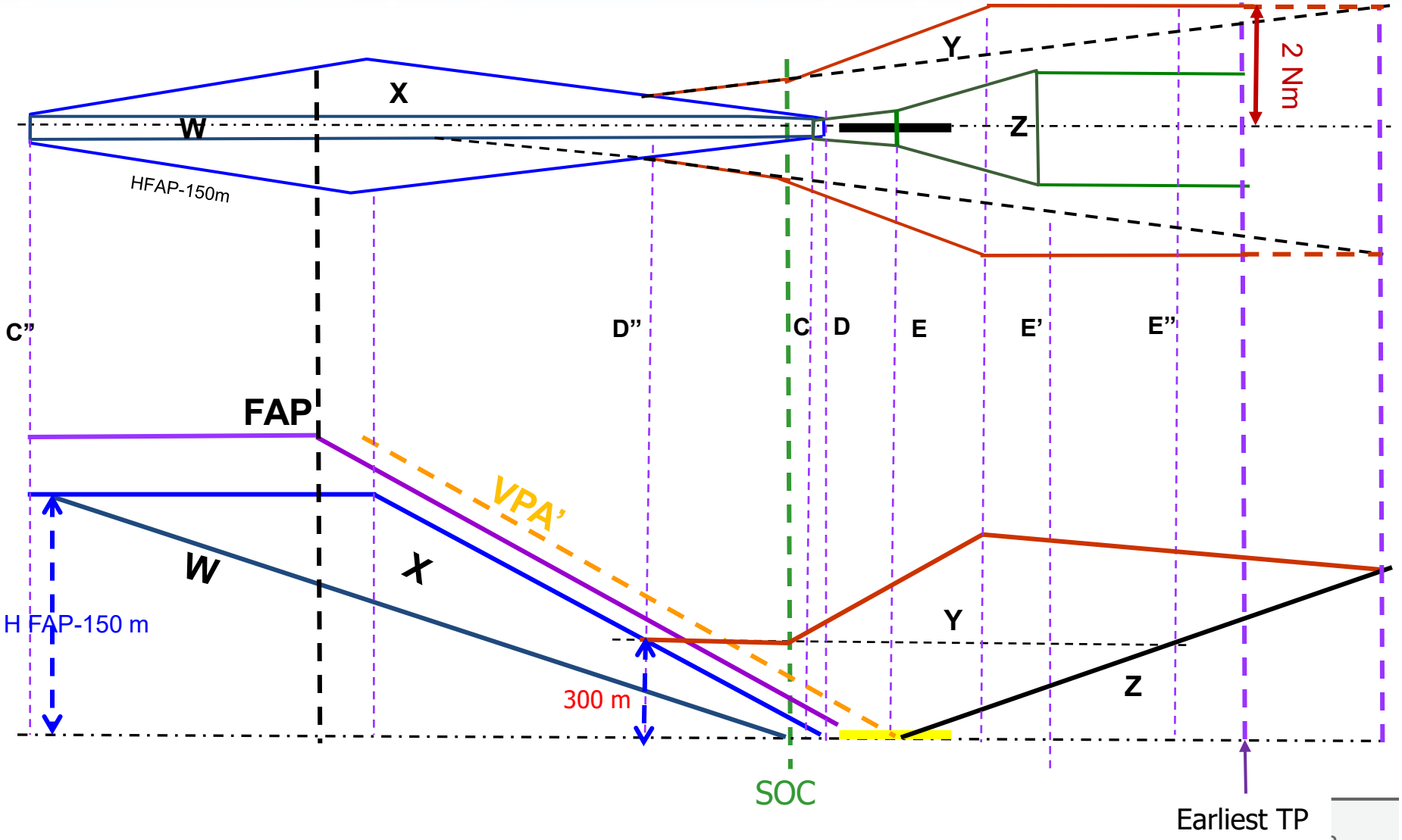
Area :

- 15° splay from width at SOC position until ½ width of RNAV area. *(Iterative process as SOC is OCH dependant)*
- Extrapolation of Y and Z surface.
  - Z surface continue to splay until ½ width of RNAV area
  - Identify point E' where Z reach primary RNAV area
- Earliest location of Fix :
  - *Fly over : ATT from SOC*
  - *Fly By : ATT + (rtan A/2 + 3s)*
- Max turn angle : 90°
  - *RF Not Permitted for first leg but can be used after a TF (defined on the LOC course)*

Missed approach for ILS to RNAV : Fly Over



RNAV ILS Contour



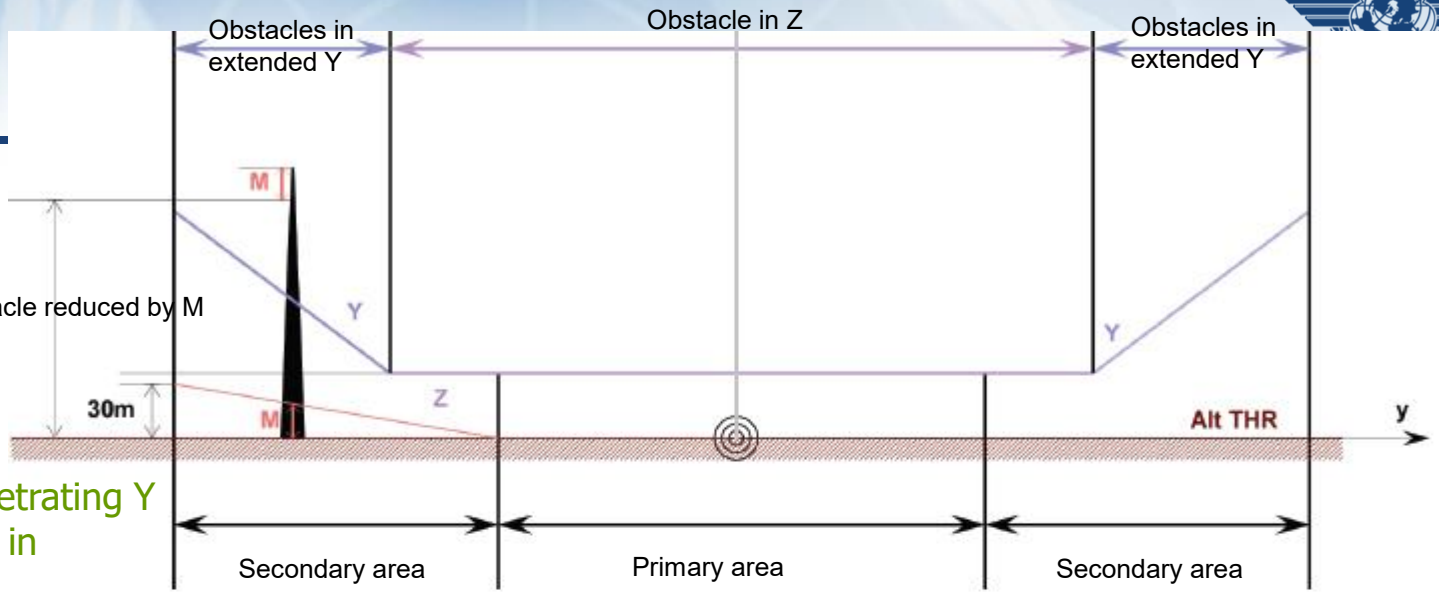
Assessment of Obstacles
OCH Computation

- Until the Point E' :
  - Use of OAS surface to compute OCH for penetrating obstacles as ILS
  - No secondary area and No MOC to use

- After the point E' until earliest TP:
  - Primary area :
    - Use of Z surface (no MOC) and OCH computation for penetrating obstacles as in ILS
  - Secondary area :
    - ***Identify obstacles penetrating Y, Y extended or Z***
    - Reduce obstacles by M (linearly reduced from 30m at the edge of secondary area to 0 at the edge of primary area)
    - Compute Heq using Hma=Hobs –M
    - Compute OCH = Heq + HL

- After earliest TP (Turn area)
  - 50m or 30m MOC in primary linearly decreasing in secondary area.
  - Obstacle not penetrating Y (from earliet TP) in the other side of the turn can be not considered for OCH computation.

Sectional view (after point E')

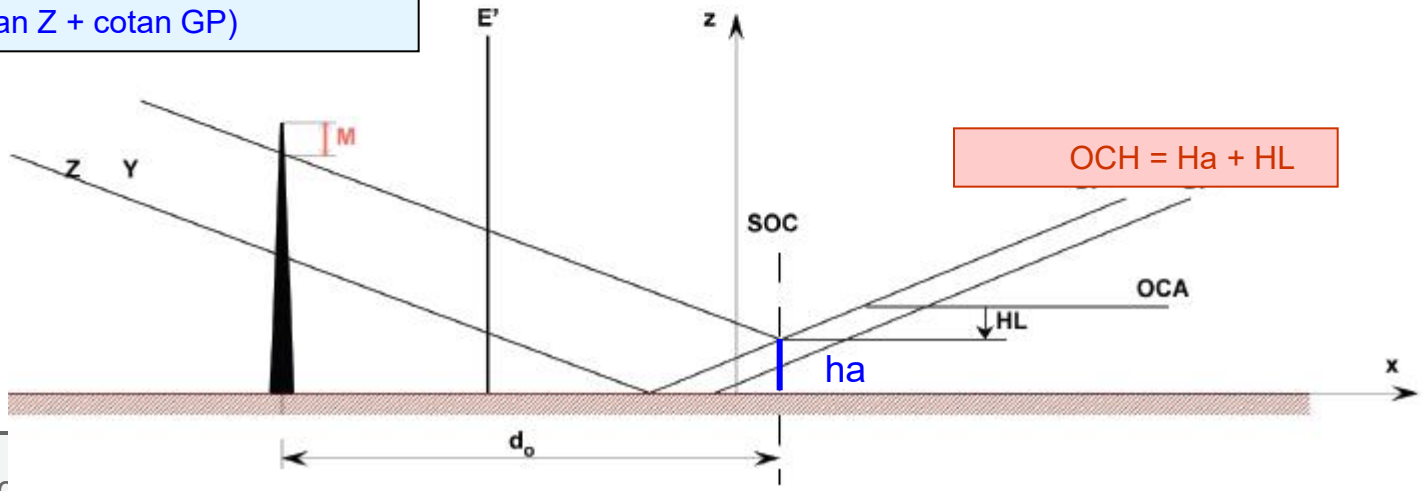


•Obstacle in penetrating Y and it is located in secondary area:

Hma = (hobst – M)

$$ha = \frac{(hobst - M)\ \text{cotan}\ Z + (xobs + 900)}{(\text{cotan}\ Z + \text{cotan}\ GP)}$$

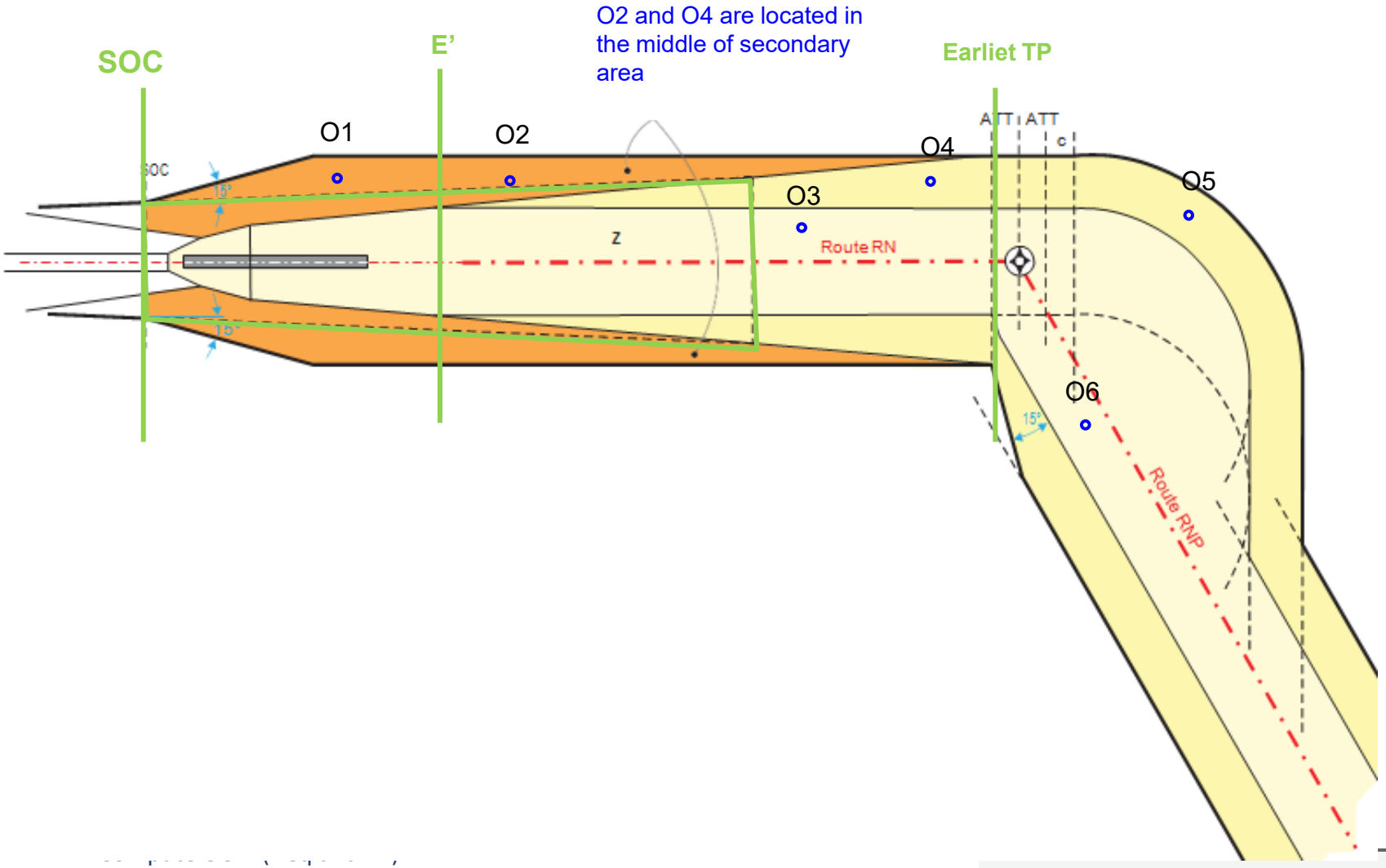
Profile view (after point E')



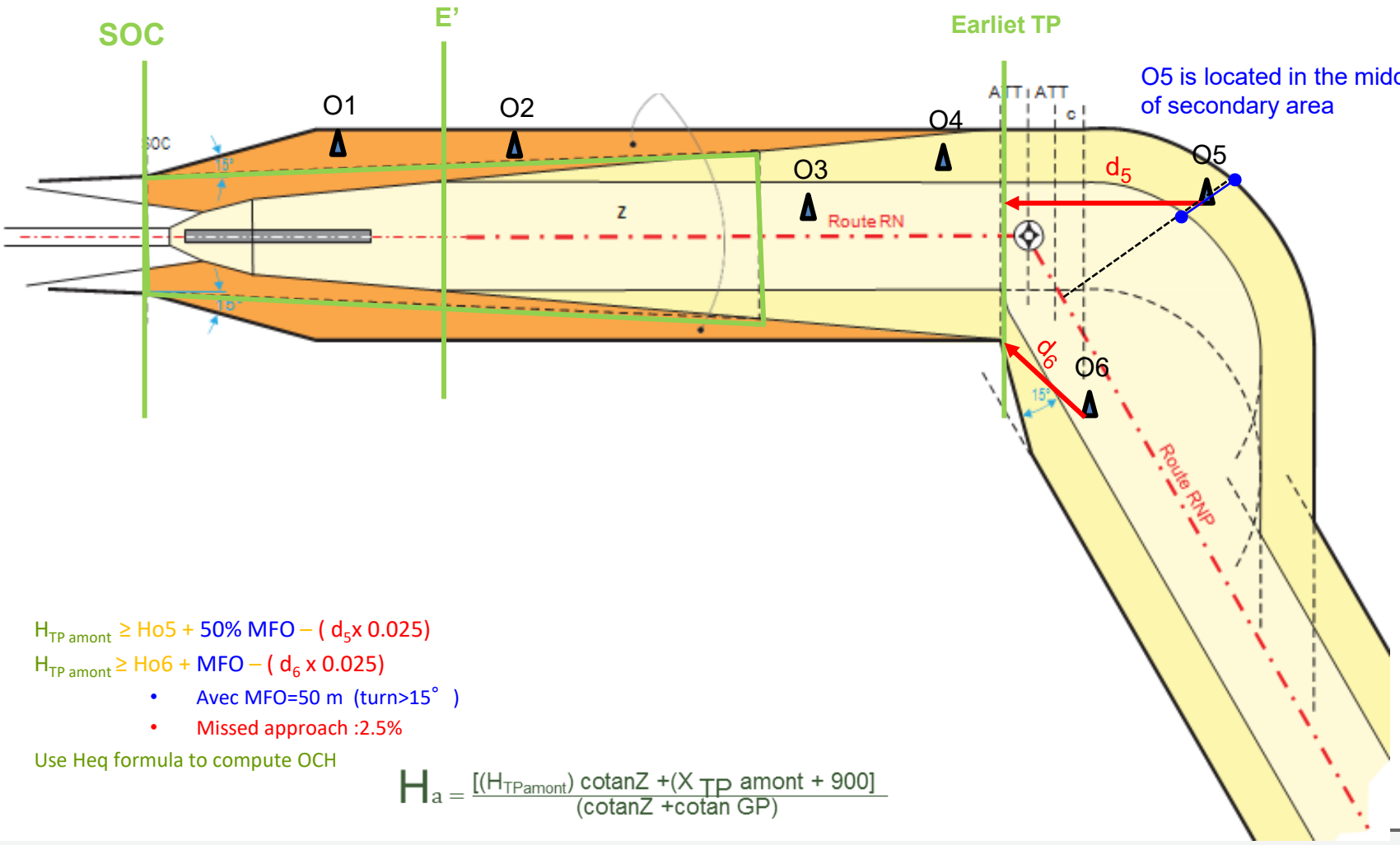
OCH = Ha + HL

Missed Approach : Turning Point

Between SOC and Earliest TP



After earliest TP



1

2

3

- $H_{TP\ amont} \geq Ho5 + 50\%\ MFO - (d_5 \times 0.025)$
- $H_{TP\ amont} \geq Ho6 + MFO - (d_6 \times 0.025)$
  - Avec MFO=50 m (turn>15°)
  - Missed approach :2.5%
- Use Heq formula to compute OCH

$$H_a = \frac{[(H_{TPamont})\ cotanZ + (X_{TP\ amont} + 900]}{(cotanZ + cotan\ GP)}$$

Fly By TP with Earliest TP before E'

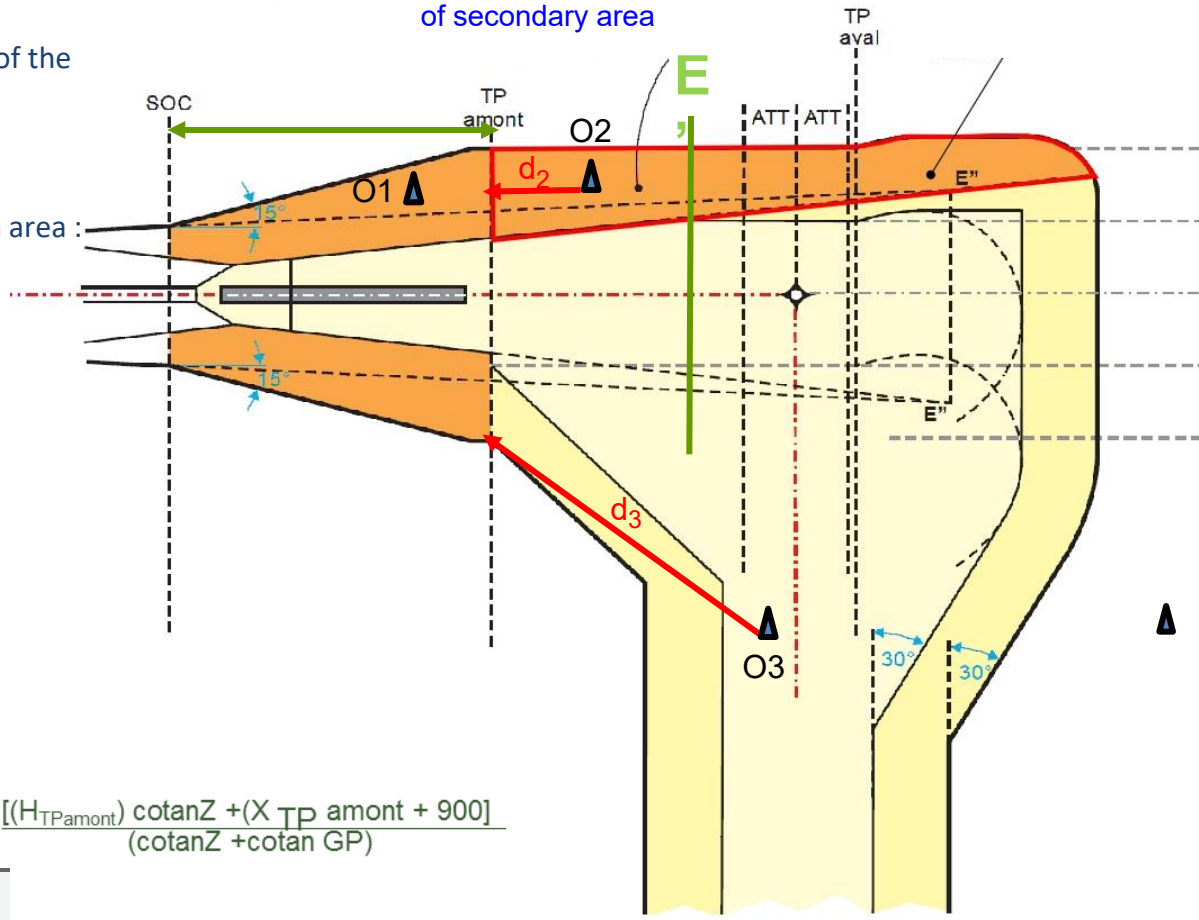
≥ ATT + r tanA/2 + 3 sec

- Straith part until Earliest TP :
  - IF O1 penetrates Y => compute OCH
- After earliest TP
  - Assess obstacle below Y in the other site of the turn
  - No penetration => not assessed for OCH computation
  - If penetration + other obstacle in the turn area :

- Compute H at earliest TP:
  - $H_{TP\ amont} \geq Ho2 + 50\%\ MOC - (d_2 \times 0.025)$
  - $H_{TP\ amont} \geq Ho3 + MOC - (d_3 \times 0.025)$
    - Avec MOC=50 m (turn>15 °)
    - And missed :2.5%
- Use Heq formula to compute OCH

Obstacle below Y in the other side of turn might be not assessed

O2 is in the middle of secondary area



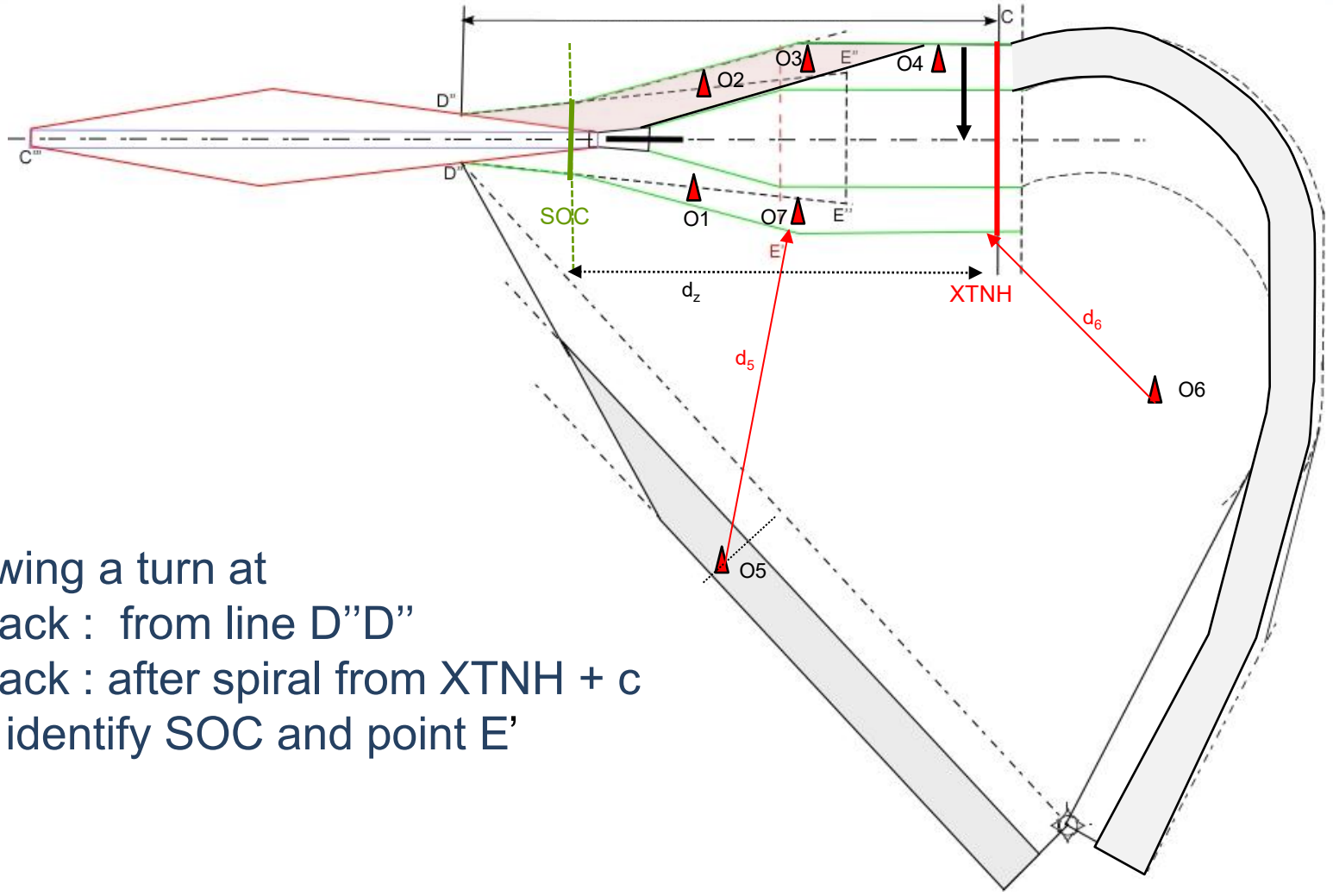
$$H_a = \frac{[(H_{TPamont})\ cotanZ + (X_{TP\ amont} + 900]}{(cotanZ + cotan\ GP)}$$

Missed Approach : Turning Altitude

Turn at an altitude

- Location of latest TNH : TNH = OCH –HL + dz TanZ
  - dz = distance SOC / XTNH
- Turn initiation area:
  - Earliest limit DD''
  - Latest limit : dz = (TNH – [OCH - HL]) / tan Z
  - TNH ≥ Ho + 50m for turn > 15°
  - TNH ≥ Ho for turn ≤ 15°
  - Assessment of obstacle in straight area (30m MOC + distance SOC/Obst)
- Turn Area
  - TNH ≥ Ho + 50m - do tan z for turn > 15°
  - TNH ≥ Ho for turn ≤ 15°
  - do = shorter distance to turn inititation area
- Turn as soon as possible
  - TNH= OCHps -HL
  - dz=0

Protection Area



- DF following a turn at
- Latest track : from line D''D''
- Latest track : after spiral from XTNH + c
- Need to identify SOC and point E'

Assessment of Obstacles

Straight part :In the turn intitiation area

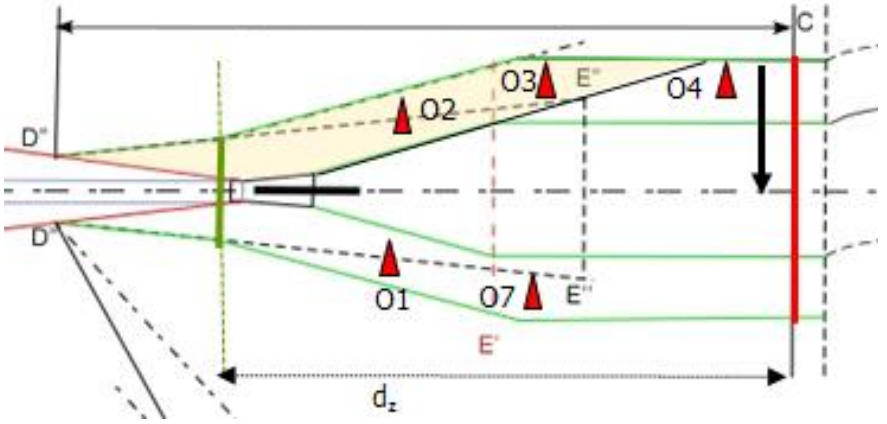
- O1 and O2 are before E' and in the Y area:
  - If penetration of Y :
    - Compute Heq using full height of O1 and O2
- O3, O4 and O7 are between E' and XTNH :
  - Assess penetration of Y for O3 and O7 : Yes for O7
  - Assess penetration of Z for O4 : Yes
  - Compute Heq for O4 and O7 :

AS onstacles are situated in secondary area :

Ha7 et Ha4 with Hma =[Hobstacle –(50% x M)]

With M=30m and all obstacles are in the middle of RNAV secondary area

- Compute OCH = max(Ha) + HL
- Depending result :
  - Check SOC position and 15° splay
  - Check XTNH from new SOC position if needed



Analyse des obstacles

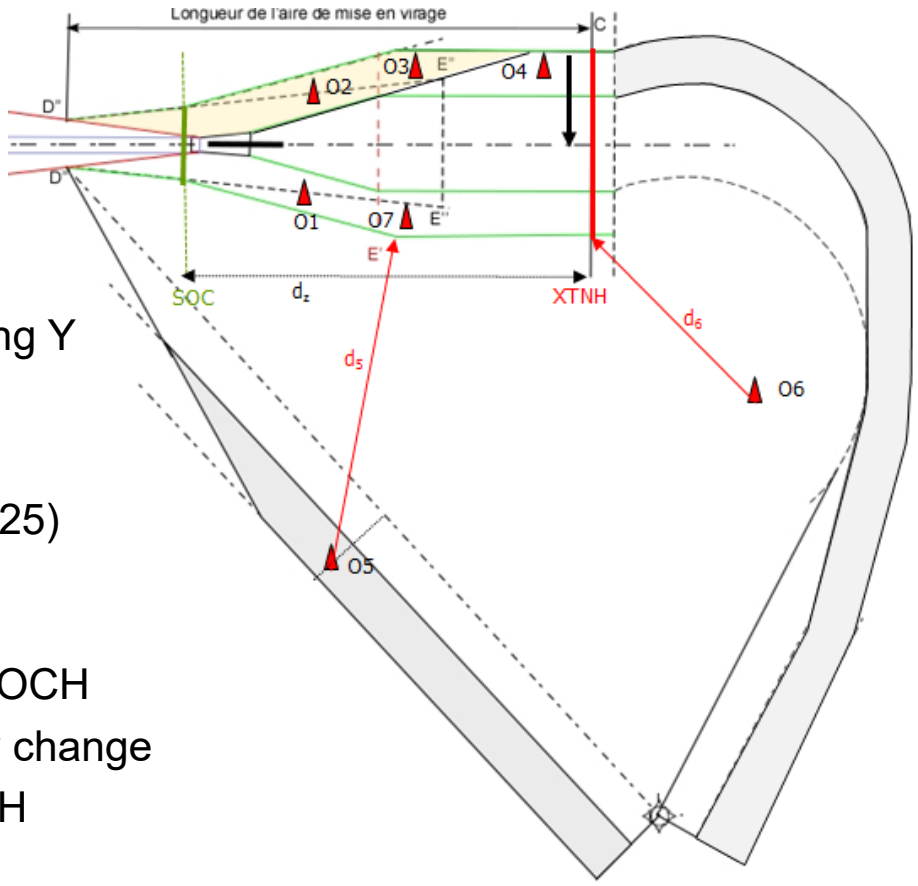
Turn area including turn initiation area

1. In Turn initiation Area, check :
   - TNH ≥ Ho1 + 50 m
   - TNH ≥ Ho2 + 50 m
   - TNH ≥ Ho7 + 50 m
   - TNH ≥ Ho4 + 50 m
   - O3 is not assessed as it is not penetrating Y
2. In turn area, check:
   - TNH ≥ Ho6 + 50 m – (d_6 x 0.025)
   - TNH ≥ Ho5 + (50% x 50 m)– (d5 x 0.025)

     O5 is located in the middle of RNAV secondary area

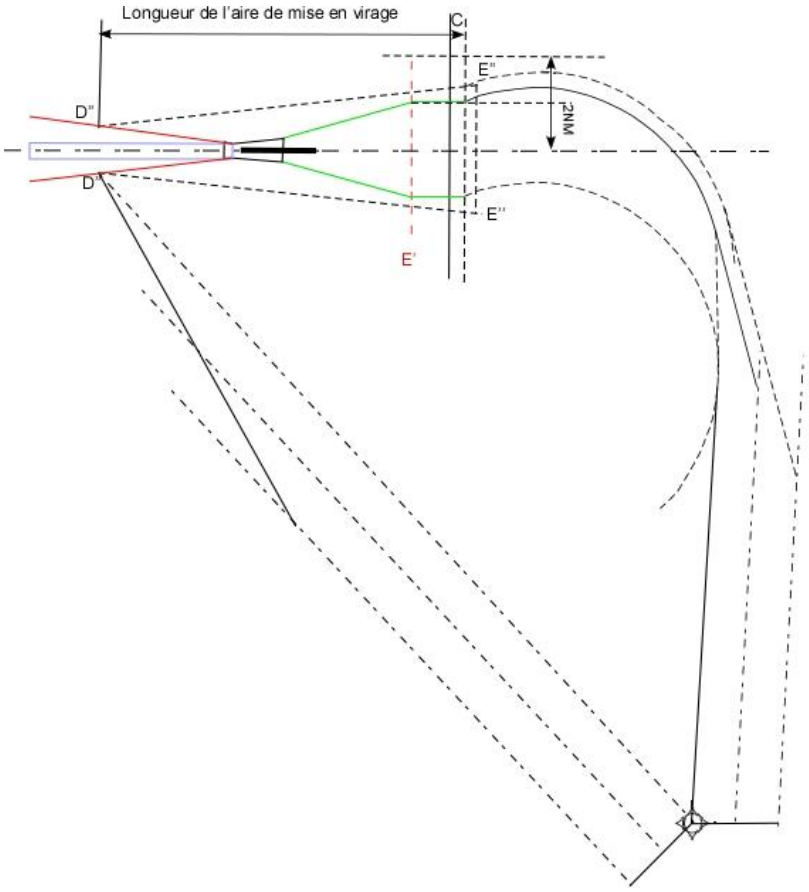
- Depending result, review TNH:
  - Without changing XTNH => increase of OCH

    => SOC location change => 15° splay change
  - Increasing XTNH without increasing OCH
  - Increase OCH and XTNH



Turn with Altitude < 300 m

Extended Y surface does’nt exist



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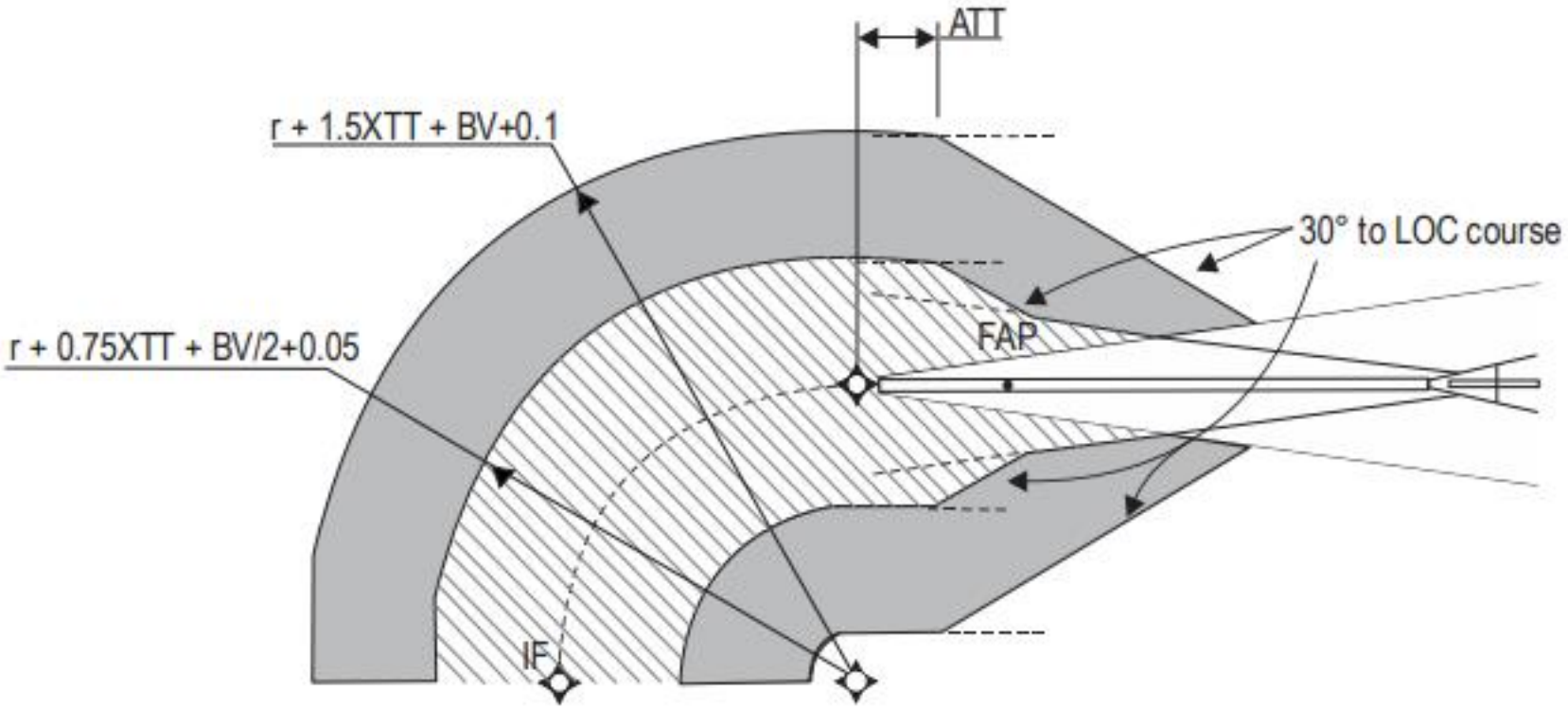
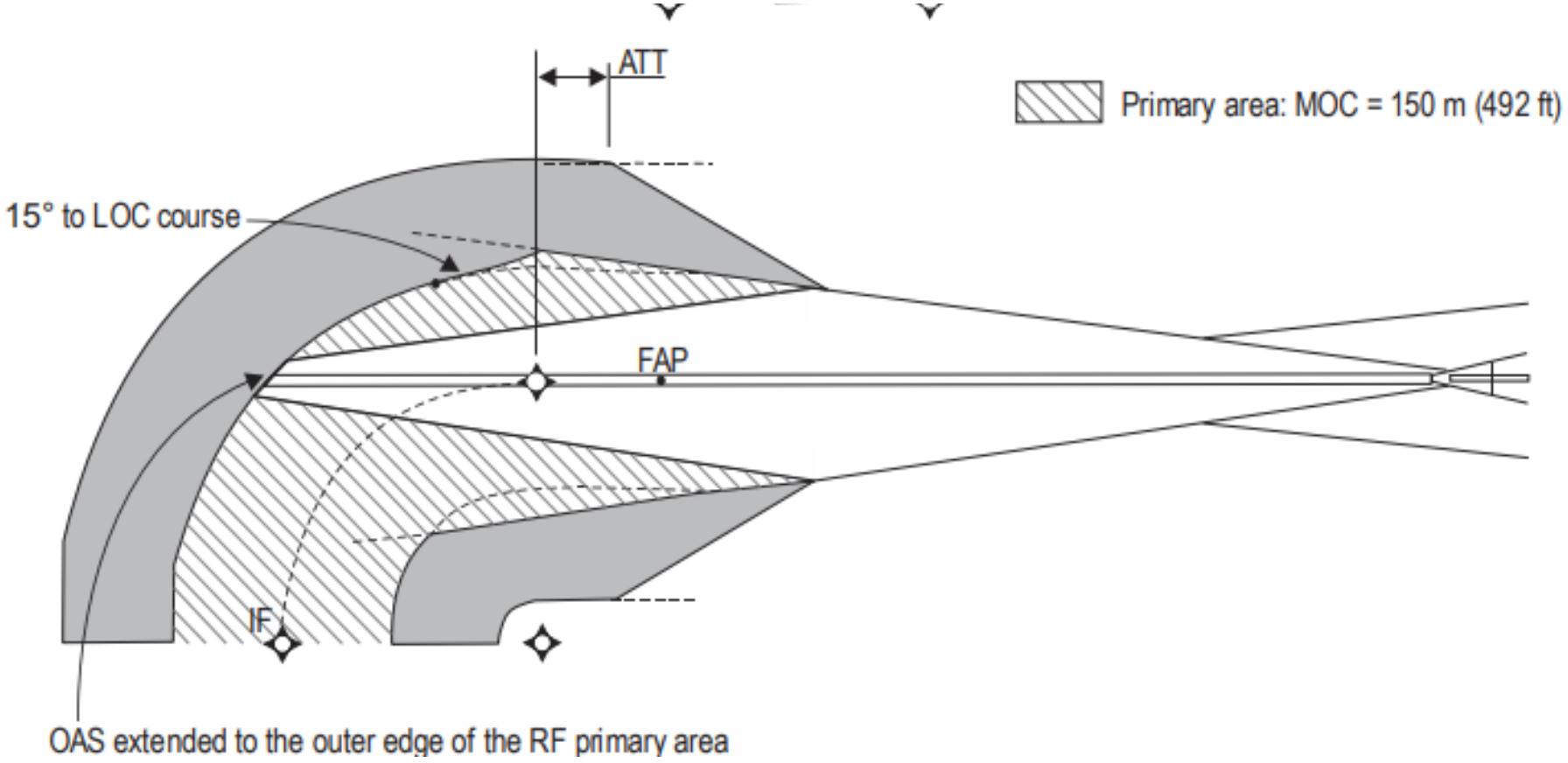
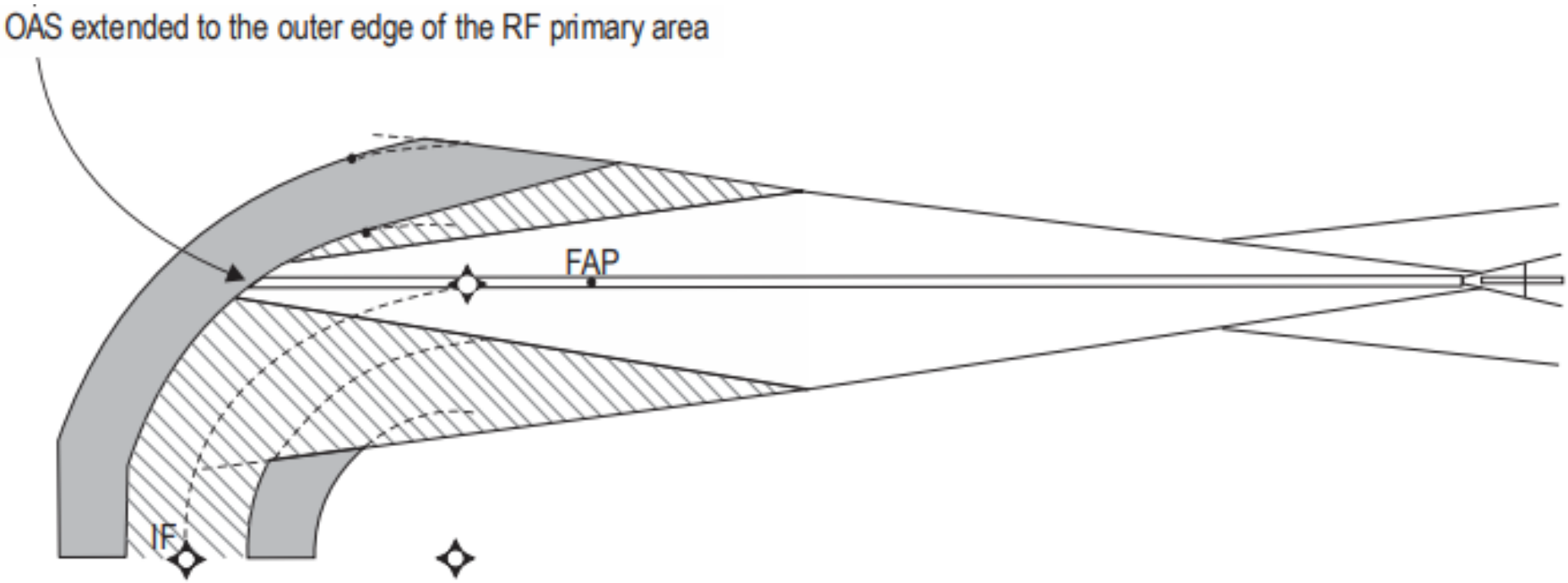
RF turn to ILS



RF turn to ILS

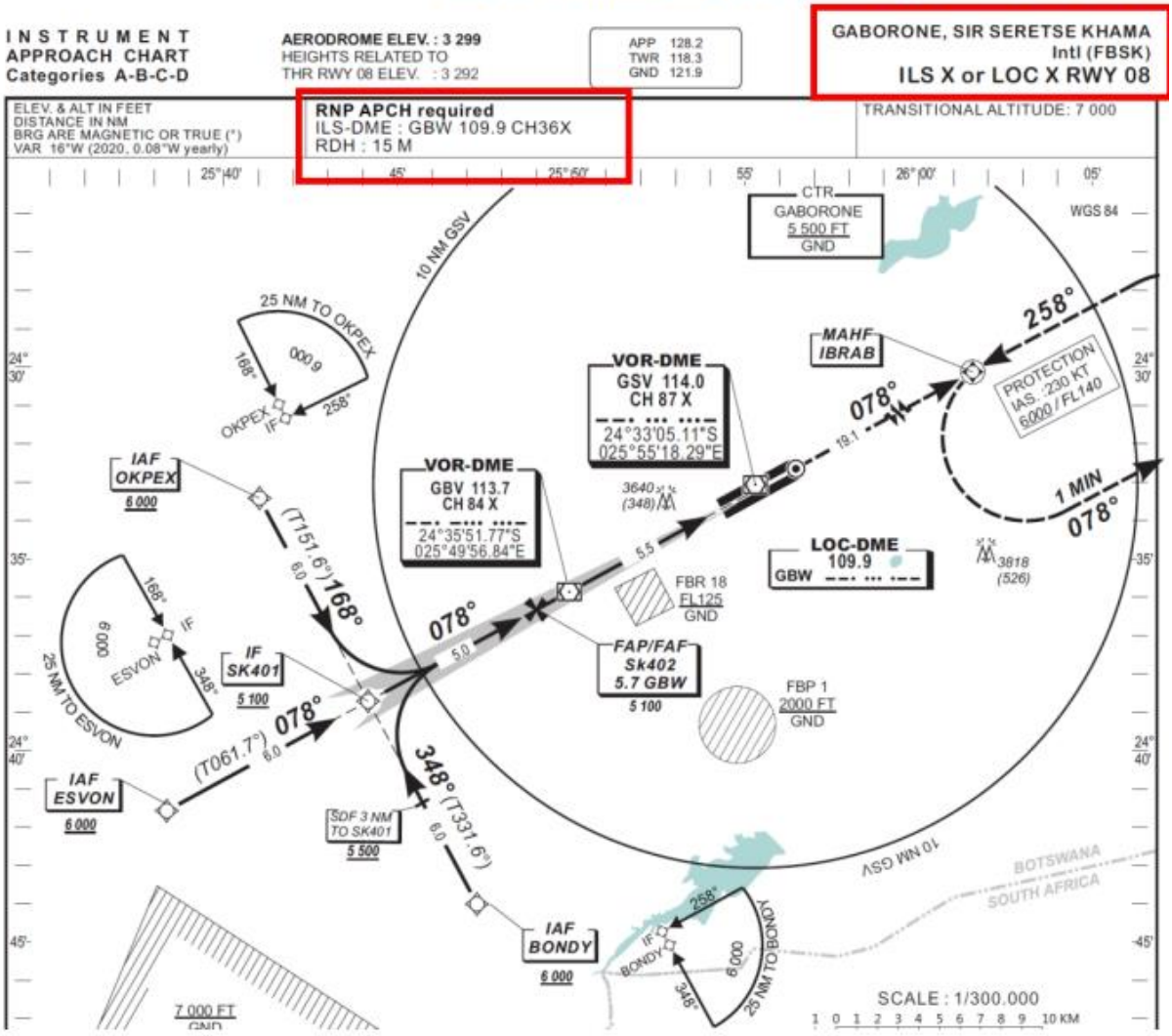


RF turn to ILS



Publication

- ILS RWY XX
- RNAV/RNP application in the PBN Box.



Q&A?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Thank You