

TURN PROTECTION

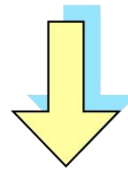


Vol II Part III

- Turn protection area
 - Section 2 chapter 2
 - Circular Arc method
 - Spiral method
 - Figure 2-21 to 2.2.6
 - Figure 2.2.10 to 2.2.13
- Non precision Approach procedure
 - Section3 chapter 2 : initial and intermediate
 - Section3 chapter 3 : Final and missed approach
- RNAV connection to ILS

STRAIGHT PROTECTION AREA

XTT calculation



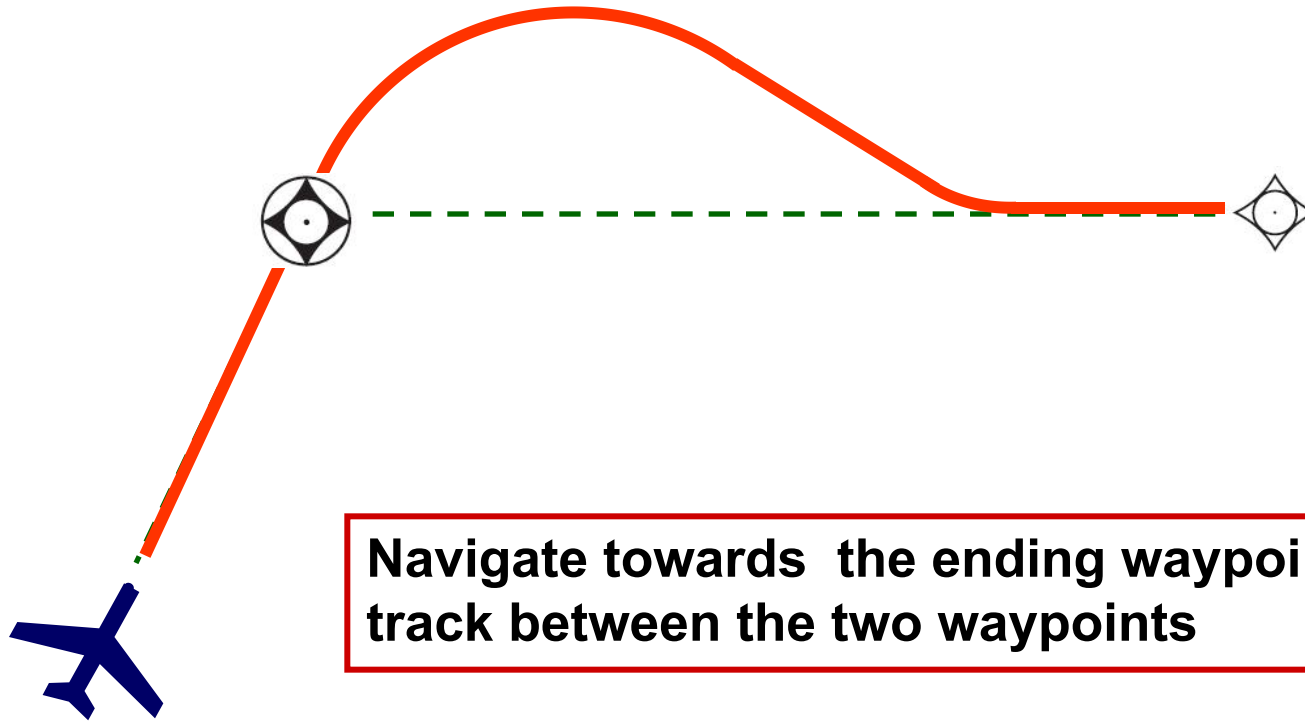
Area semiwidth
 $1/2 AW = 1.5 XTT + BV$

Straight protection
area semi-width + merging
methodology

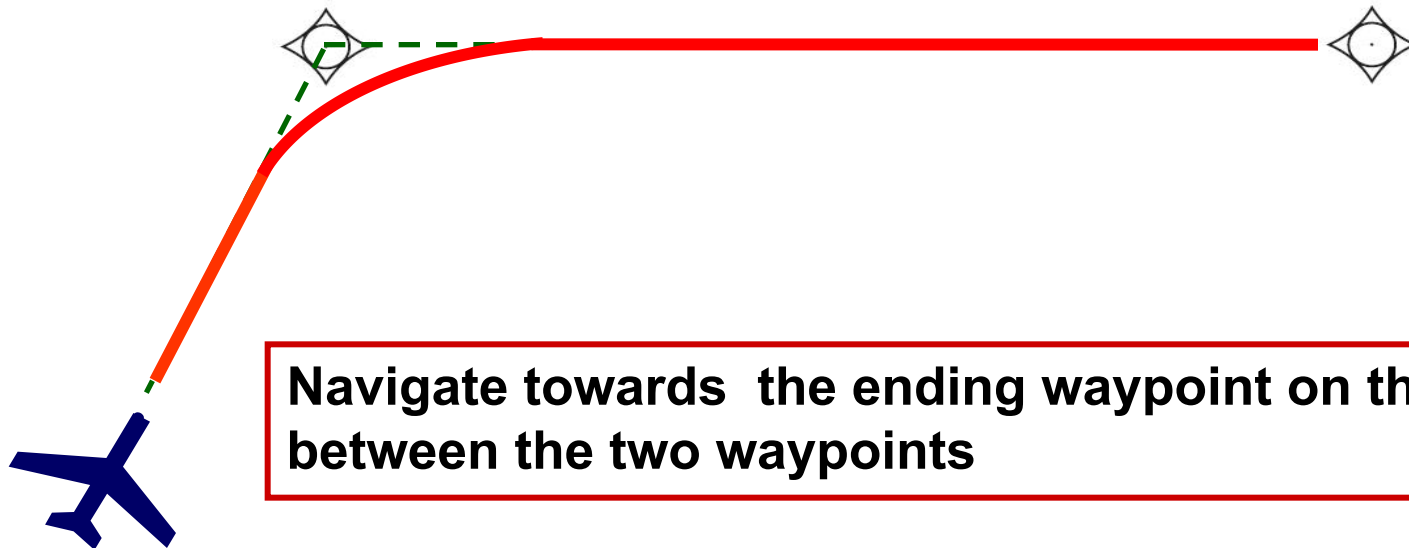
PATH TERMINATOR

Review and influence on the desired
track

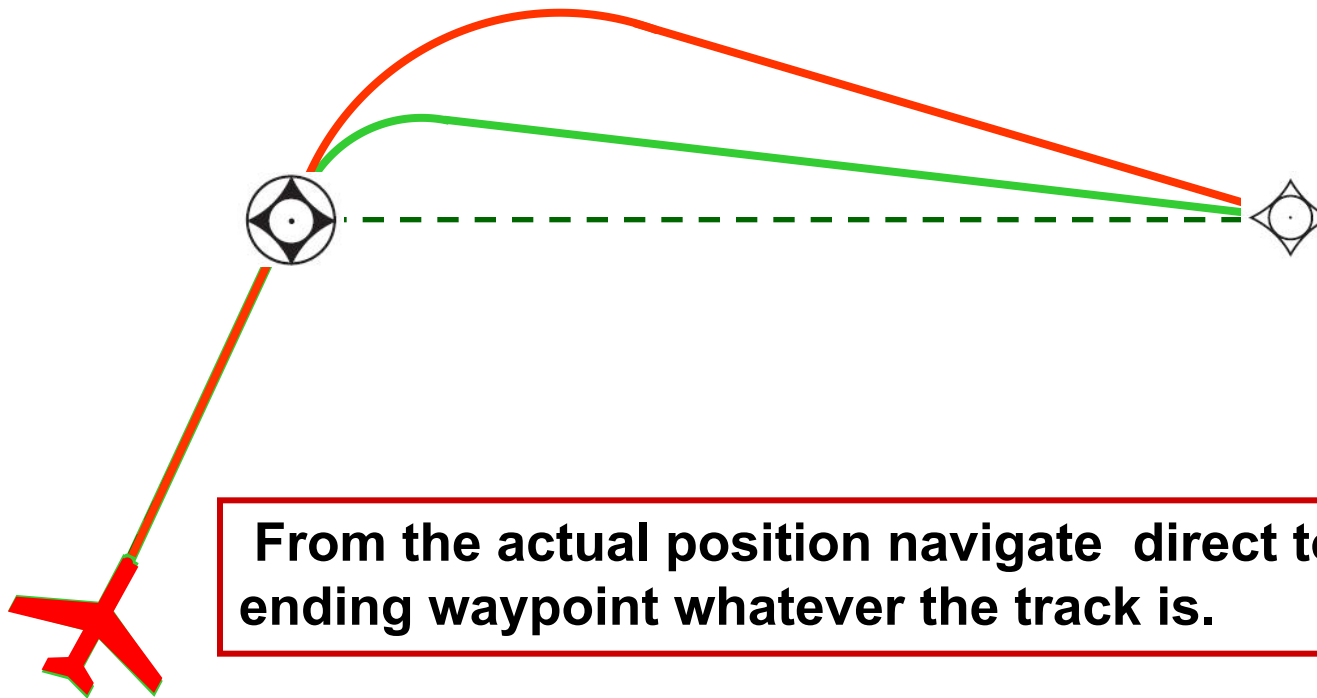
F : TRACK BETWEEN FIXES



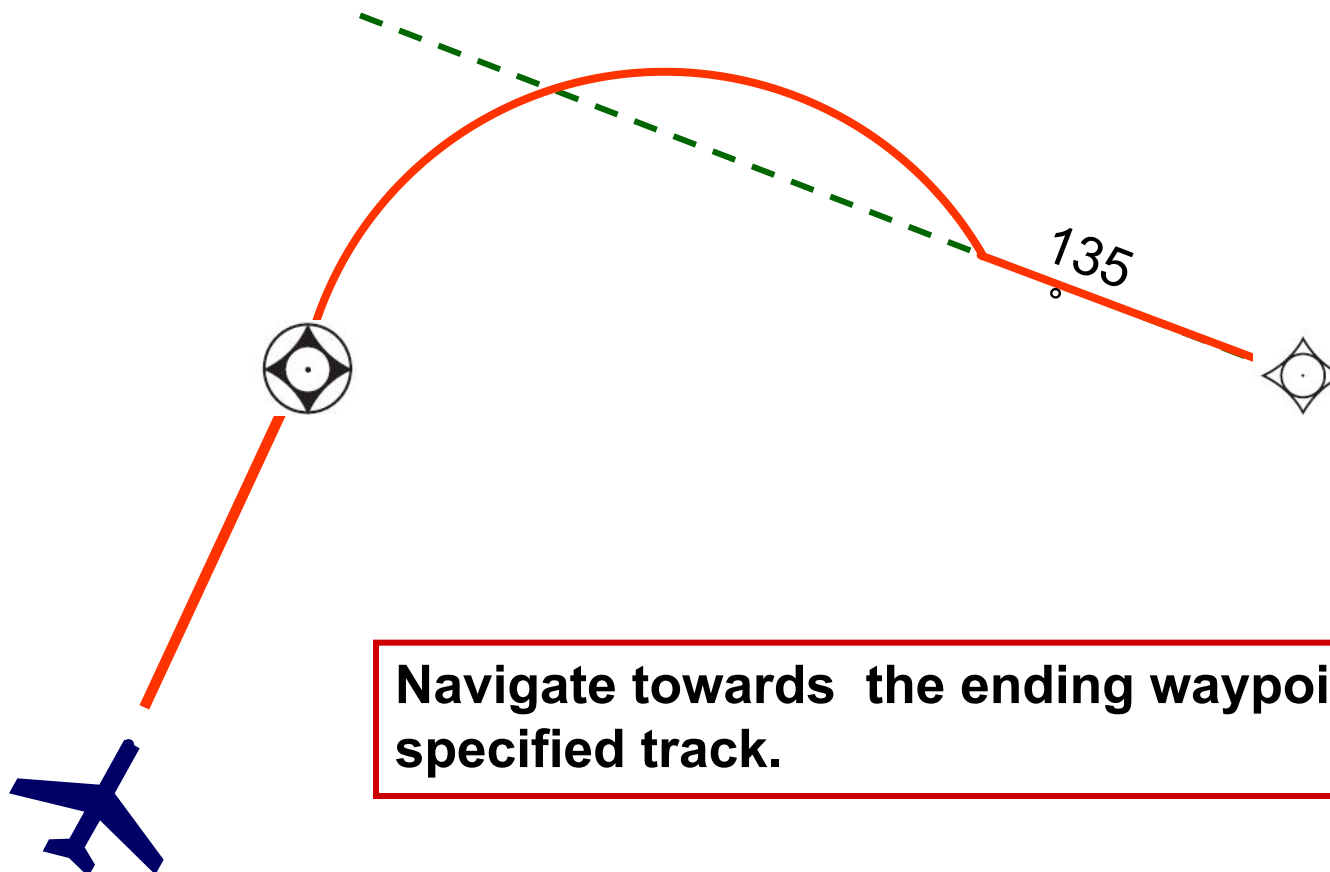
TF : TRACK BETWEEN FIXES



F : DIRECT TO FIX



CF : COURSE TO FIX

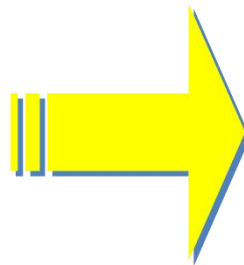


Navigate towards the ending waypoint on a specified track.

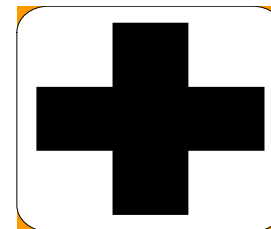
Type of waypoint

PATH Terminator

Protection area



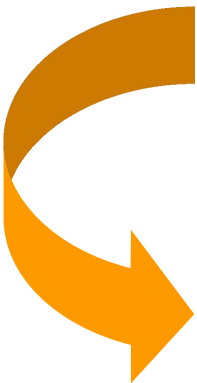
Nominal trajectory



Sensor(s)
Aircraft Category

TURN CONSTRUCTION

WHAT' S NEW (regarding non RNAV procedure)

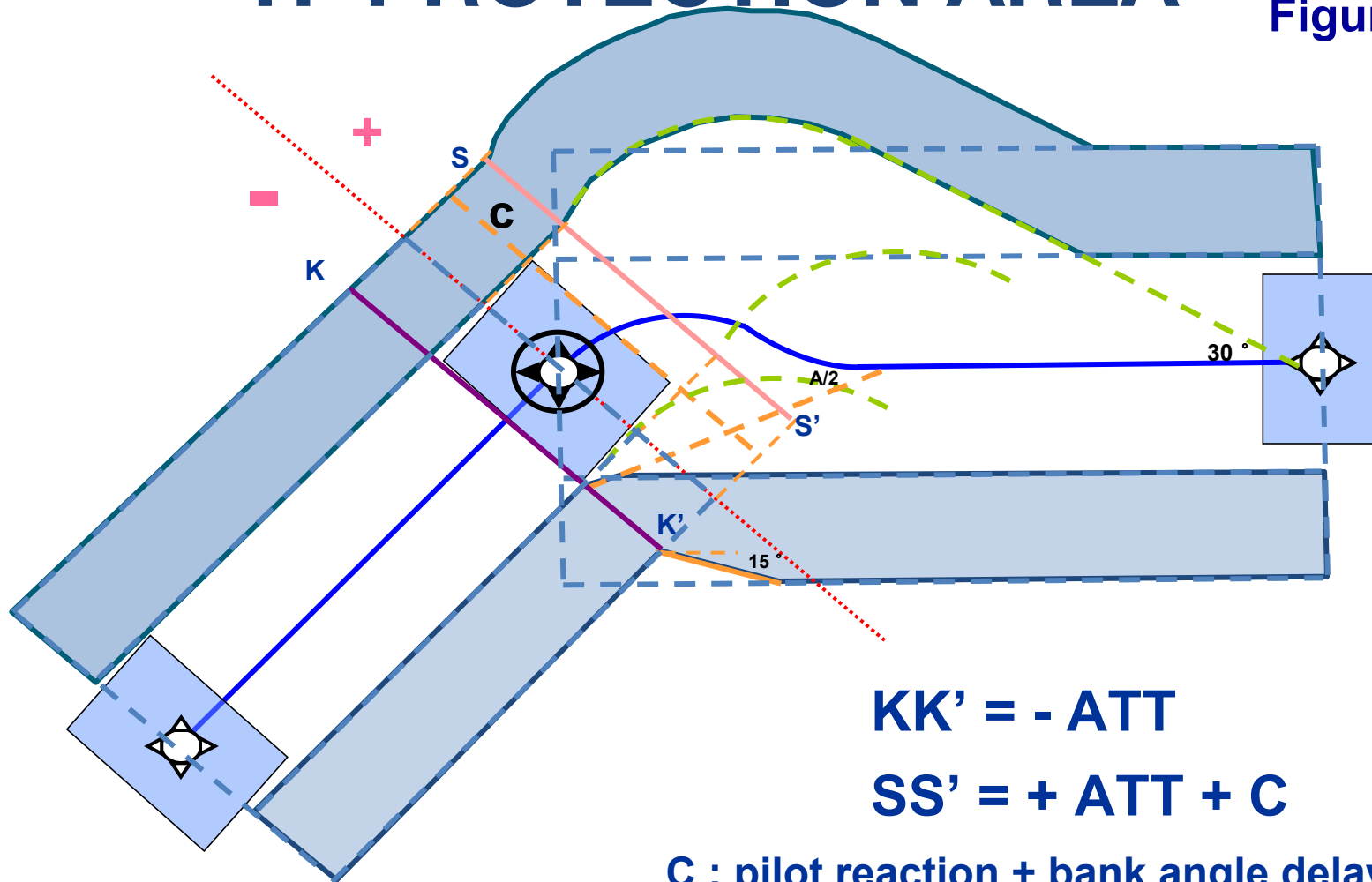
- 
- Use of wind spiral for turn protections or circular arc method
 - Max turn angle : 120° (no reversal)
 - Bank angle delay for a fly-by WP is assumed by the system
 - Protection deals with **max** TAS and **low** TAS

WHAT' S REMAINING ?

- 
- Bank angle : 25° / 15°
 - Pilot reaction delay : 6 sec / 3 Sec
 - Descent and climb gradient
 - MOC

TURN AT FLY OVER WAYPOINT : TF PROTECTION AREA

Figure III-2-2-3

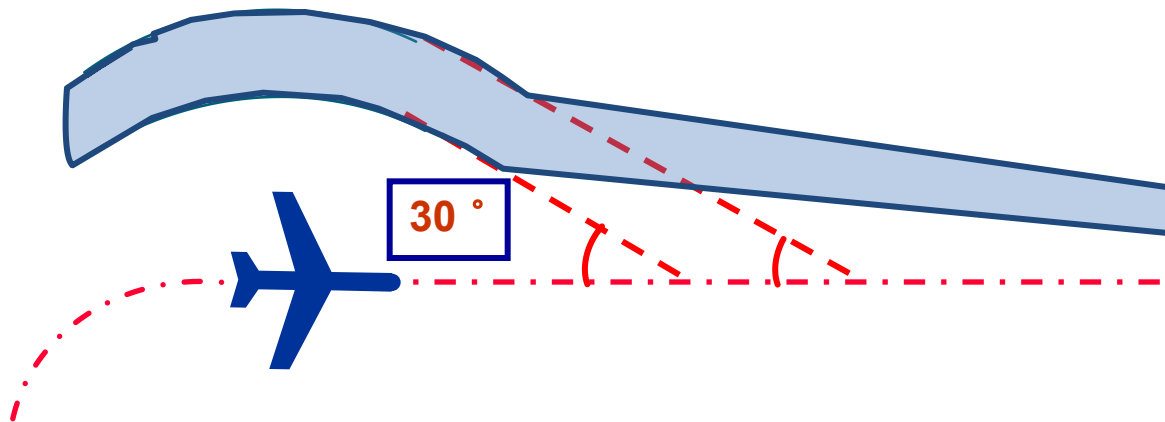


Parameters

<i>Waypoint type</i>	<i>Earliest and latest turning point criteria</i>
Flyover (Figures III-2-2-3, III-2-2-6 and III-2-2-7)	Earliest: ATT before the waypoint. Latest: ATT + pilot reaction time + bank angle delay.
Fly-by (Figures III-2-2-2, III-2-2-4 and III-2-2-5)	Earliest: ATT+ turn initiation distance before the waypoint. Latest: Turn initiation distance – ATT – pilot reaction time (if the value is negative, the point is beyond the waypoint).
TA/H departure followed by a CF leg (Figure III-2-2-8)	Earliest: 600 m from the start end of the runway (the start of the runway available for take-off/TORA). Latest: The point at which the surface, beginning at 5 m above the DER, reaches the required altitude, at the prescribed PDG + pilot reaction time + bank angle delay.
TA/H departure followed by a DF leg (Figure III-2-2-9)	Earliest: 600 m from the start end of the runway (the start of the runway available for take-off/TORA). Latest: The point at which the surface, beginning at 5 m above the DER, reaches the required altitude, at the prescribed PDG + pilot reaction time + bank angle delay.
TA/H missed approach (Figure III-2-2-10)	Earliest: ATT before the MAPt. (The normal case is that the aircraft does not turn before the MAPt even when well above required altitude. A note is required to this effect on the IAC.) Latest: The point at which the surface, beginning at the SOC, reaches the required altitude, at a 2.5% climb gradient unless otherwise stated + pilot reaction time + bank angle delay.
Turn at the MAPt (Figure III-2-2-11 and III-2-2-12)	Earliest: ATT before the MAPt. Latest: SOC + pilot reaction time + bank angle delay.

CONNECTION METHOD: OUTER AND INNER TURN

- Taper with 30° relative to the nominal track

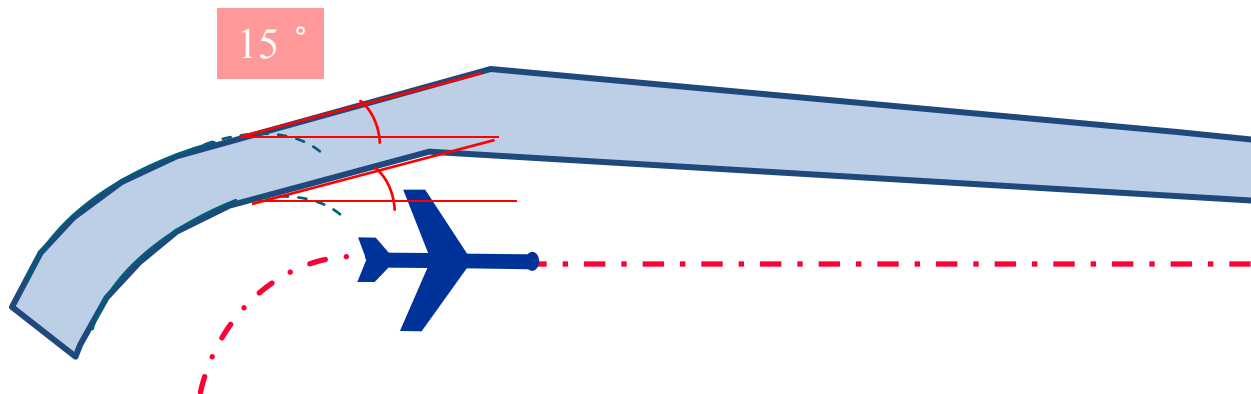


§ III-2-2-3.1.1

If the **resulting area** falls **outside** the area of the **next leg**, these areas shall be joined by a line with 30° to the **nominal** track of the **next** leg tangent to the wind spiral.

CONNECTION METHOD: OUTER TURN

- Tangent to spiral with a 15° angle according to nominal trajectory

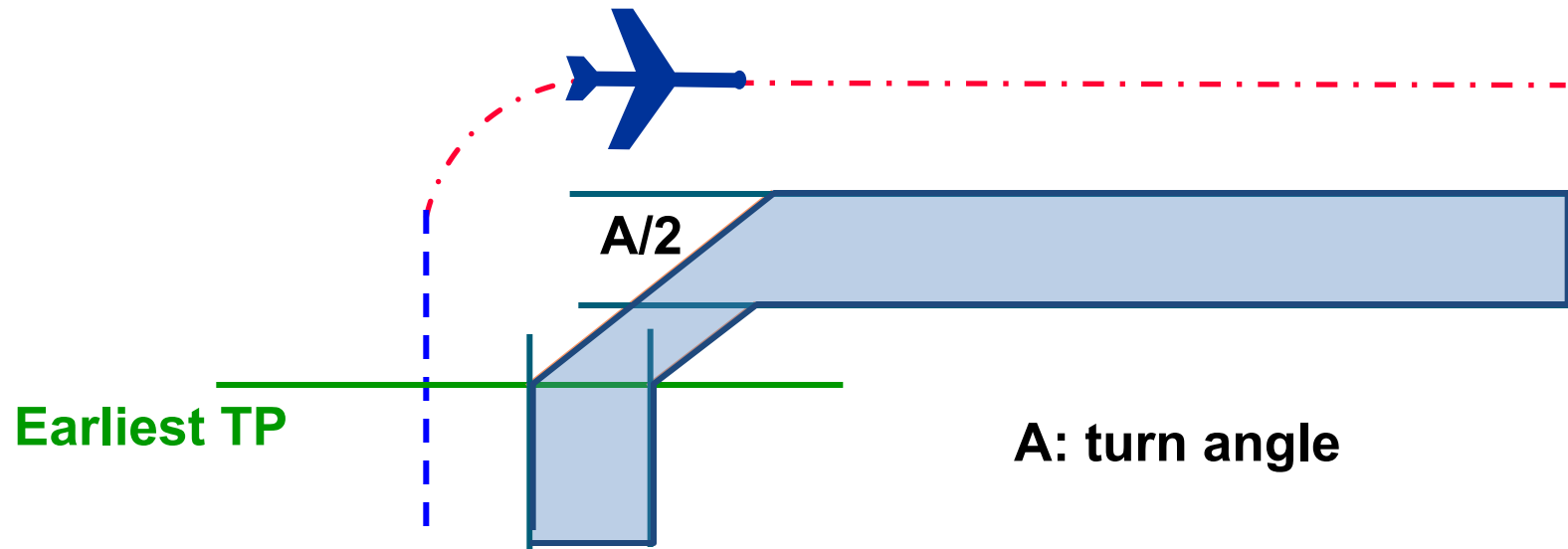


§ III-2-2-3.1.1

If the **resulting** area falls **within** the area of the **next** leg , these areas shall be joined with a 15° splay line according to the **nominal** track of the **next leg** tangent to the wind spiral .

CONNECTION METHOD: INNER TURN

- Taper with half turn angle ($A/2$) relative to the nominal track

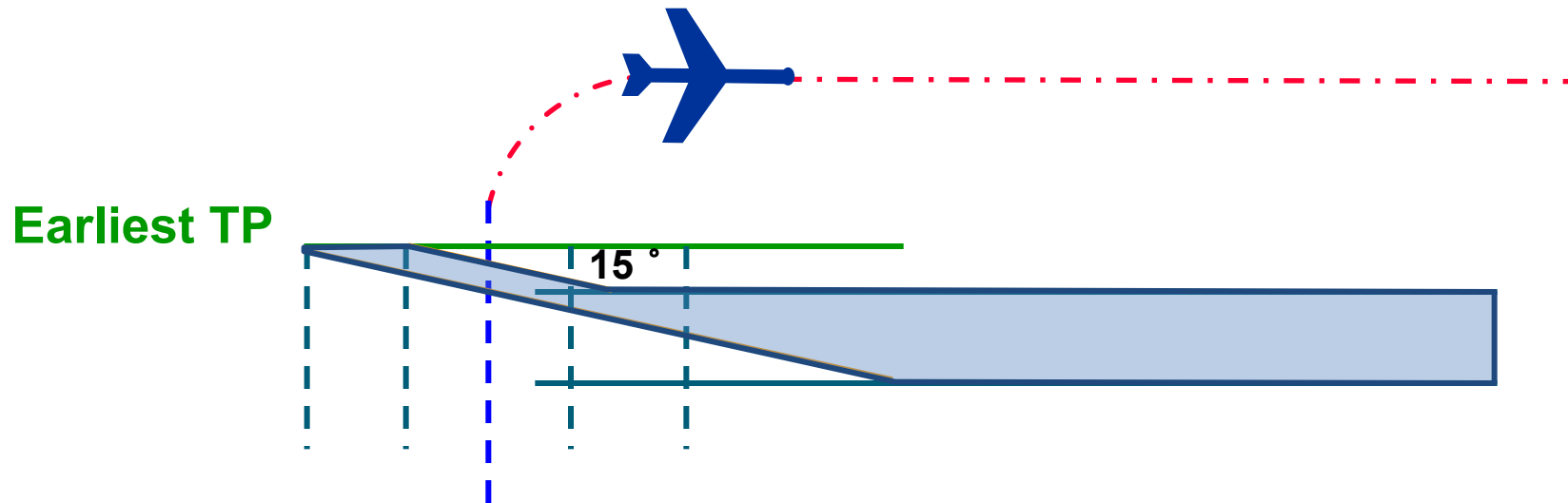


§ III-2-2-3.2

If the area of the **previous** leg lies **outside** the area of the **next** leg the areas shall be joined at $A/2$ to the **nominal** track of the **next** leg from the most constraining **earliest** turning point.

CONNECTION METHOD: INNER TURN

- Spay with 15° relative to the nominal track

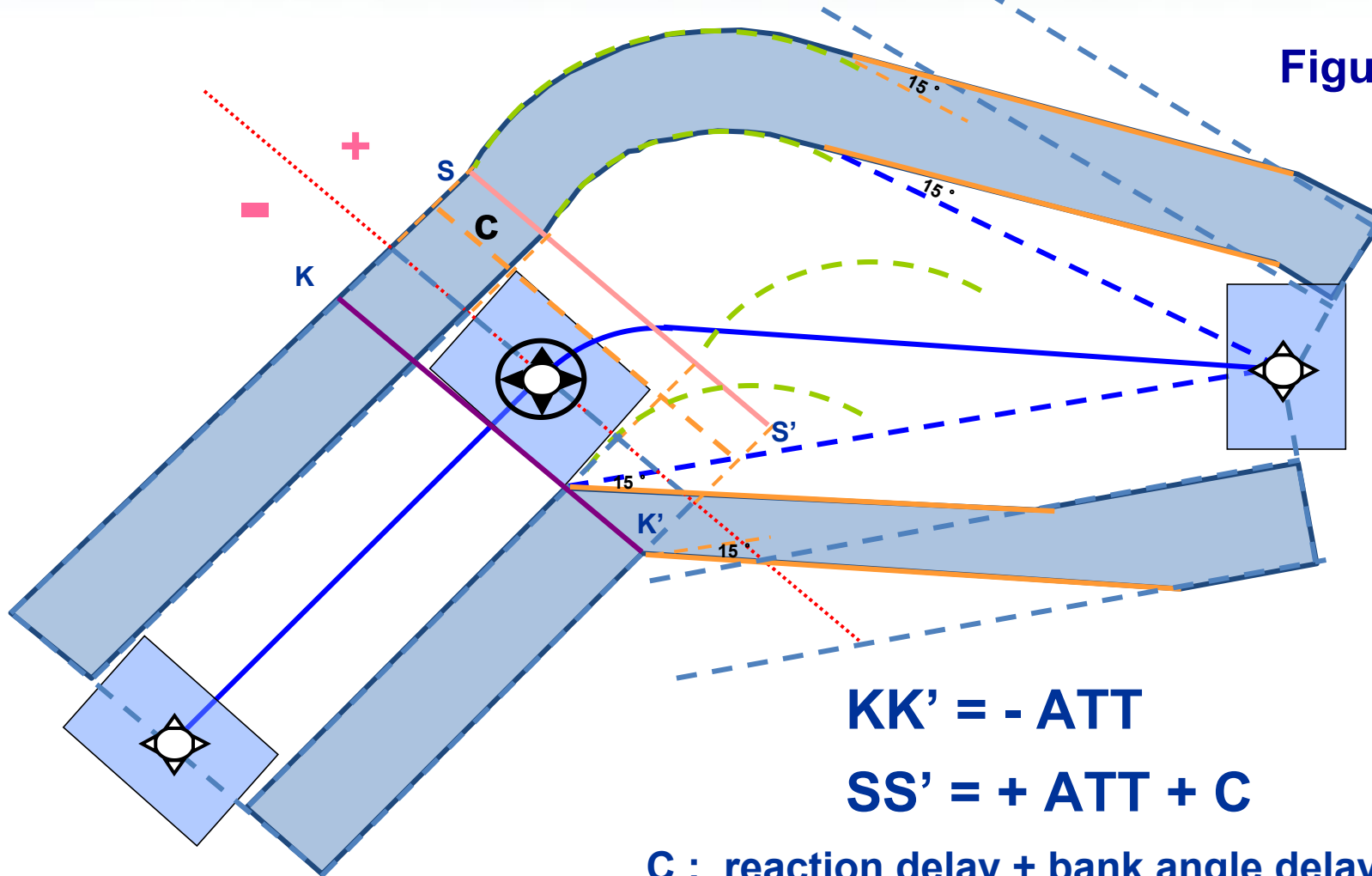


§ III-2-2-3.2

If the area of the **previous** leg lies within the area of the **next** leg the area shall be **splayed** with 15° to the nominal track of the **next** leg from the most constraining **earliest** turning point.

DF : PROTECTION AREA

Figure III-2-2-6



$$KK' = - ATT$$

$$SS' = + ATT + C$$

C : reaction delay + bank angle delay



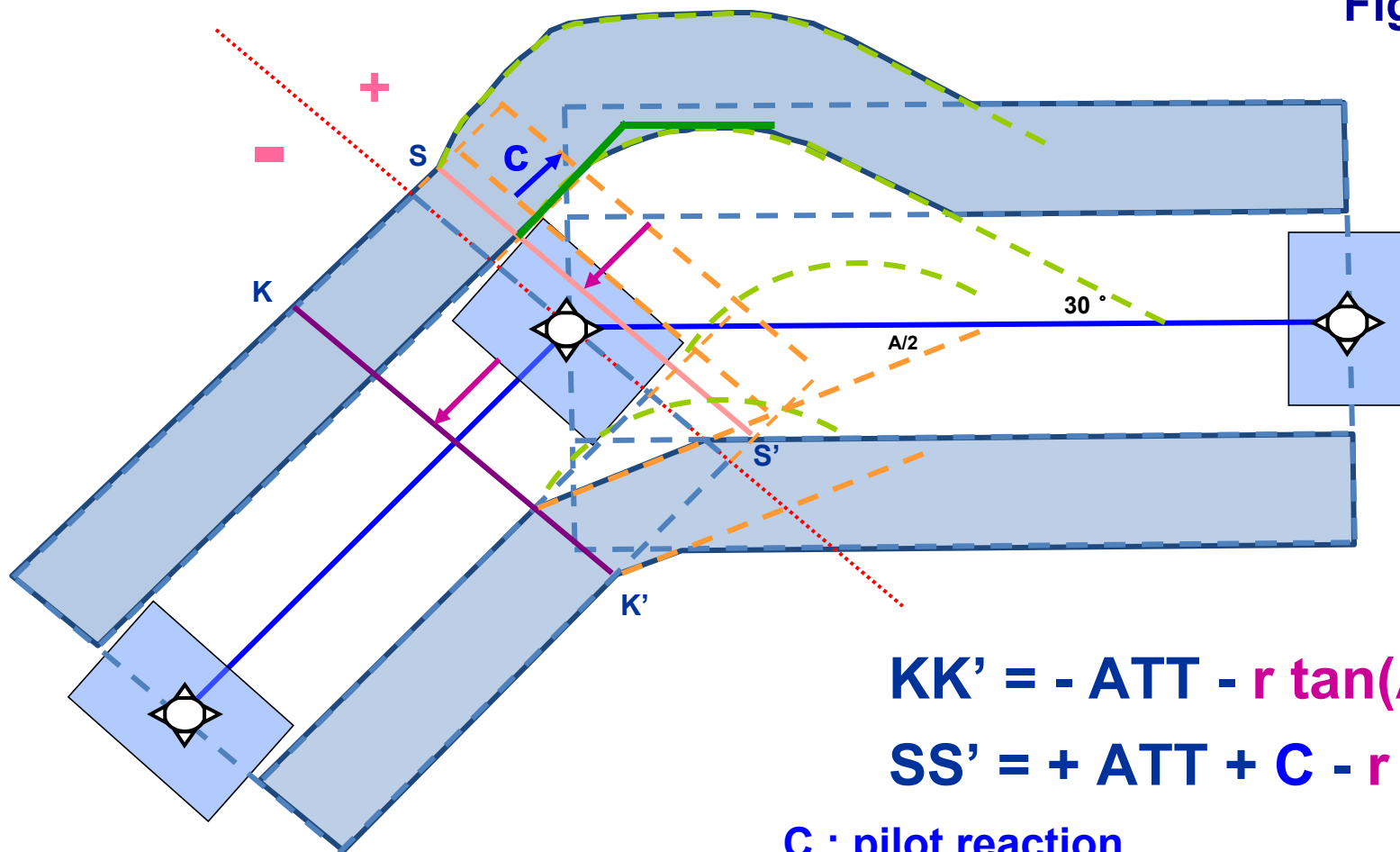
REMINDER



- For protection with **DF** path terminator consider **earliest track** and **latest track**
- Connection method is different for **inner** and **outer side** of turn

Modelling low speeds

Figure III-2-2-5

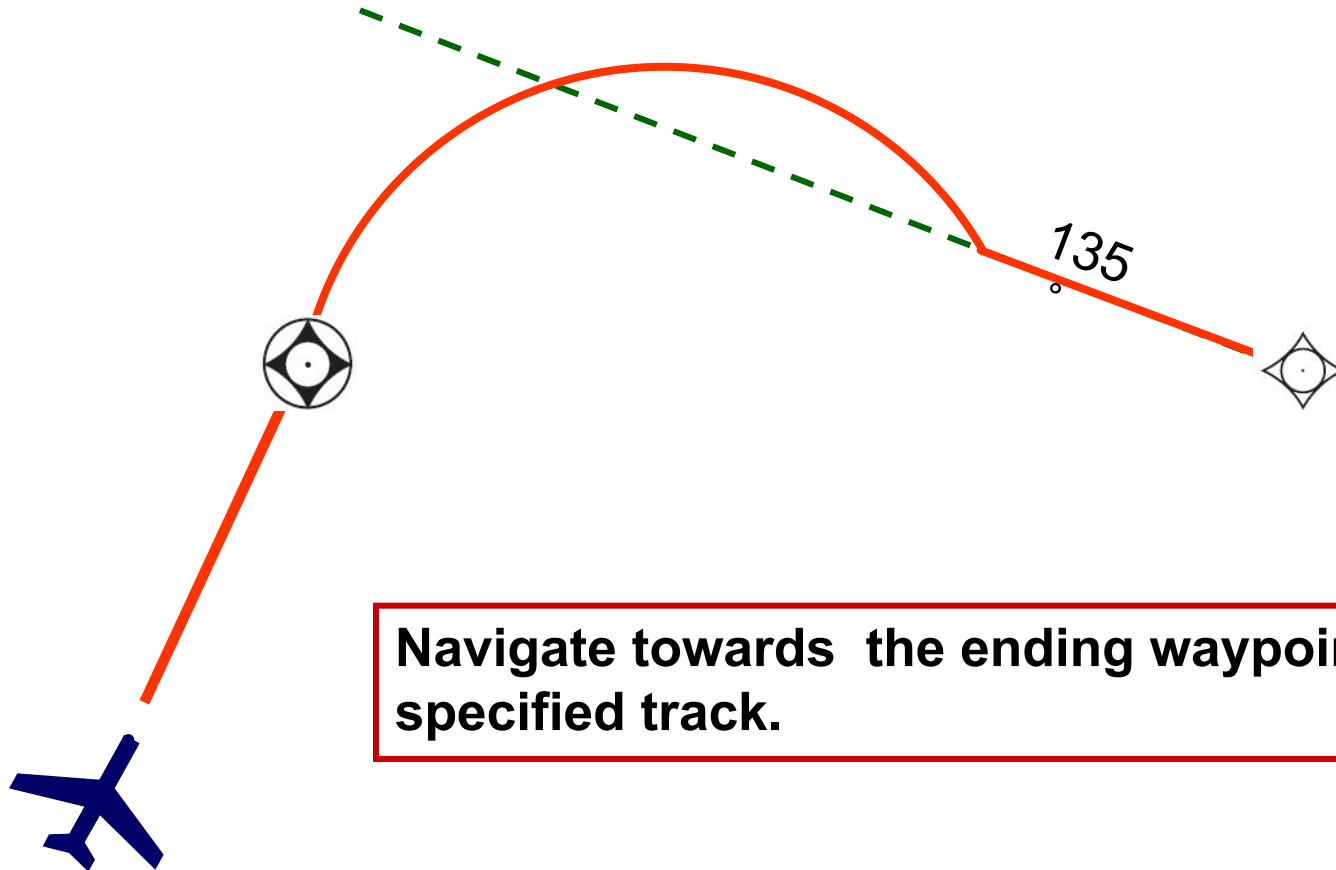


$$KK' = - ATT - r \tan(A/2)$$

$$SS' = + ATT + C - r \tan(A/2)$$

C : pilot reaction

CF : COURSE TO FIX



TURN AT FLY BY WAYPOINT

TF PROTECTION AREATURN ANGLE $\leq 90^\circ$

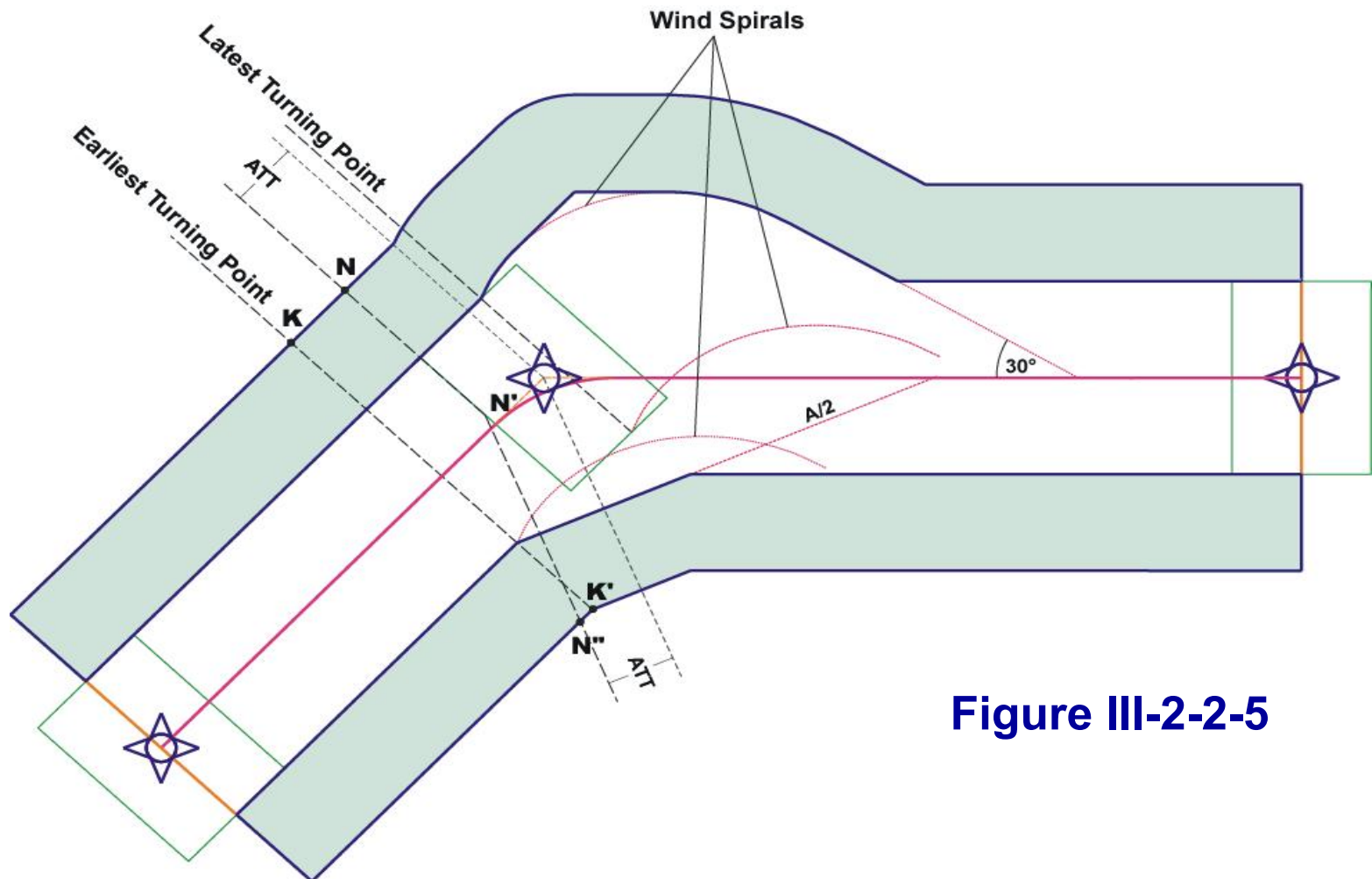


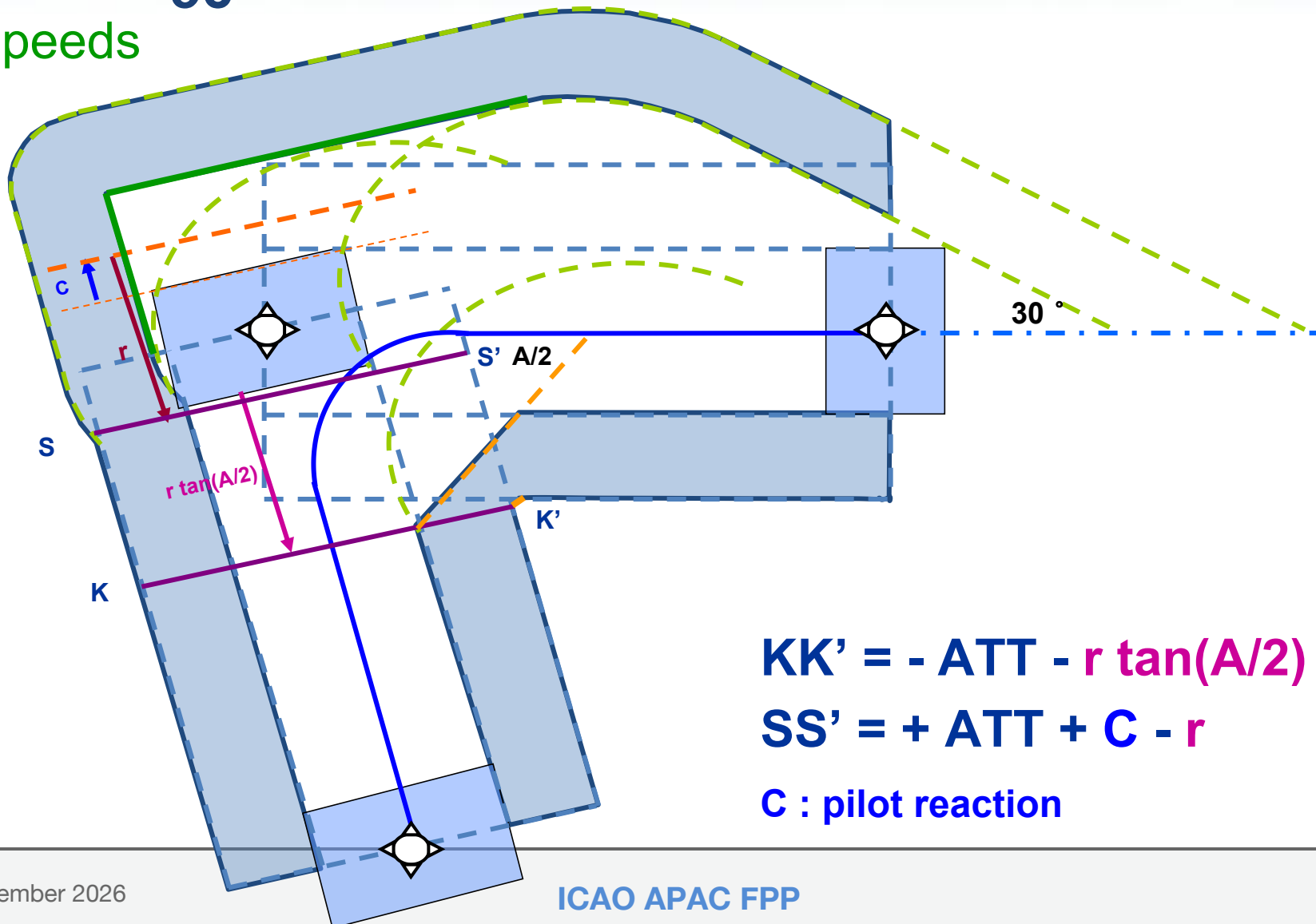
Figure III-2-2-5

TURN AT FLY BY WAYPOINT

TF PROTECTION AREATURN ANGLE >

90°

Low speeds

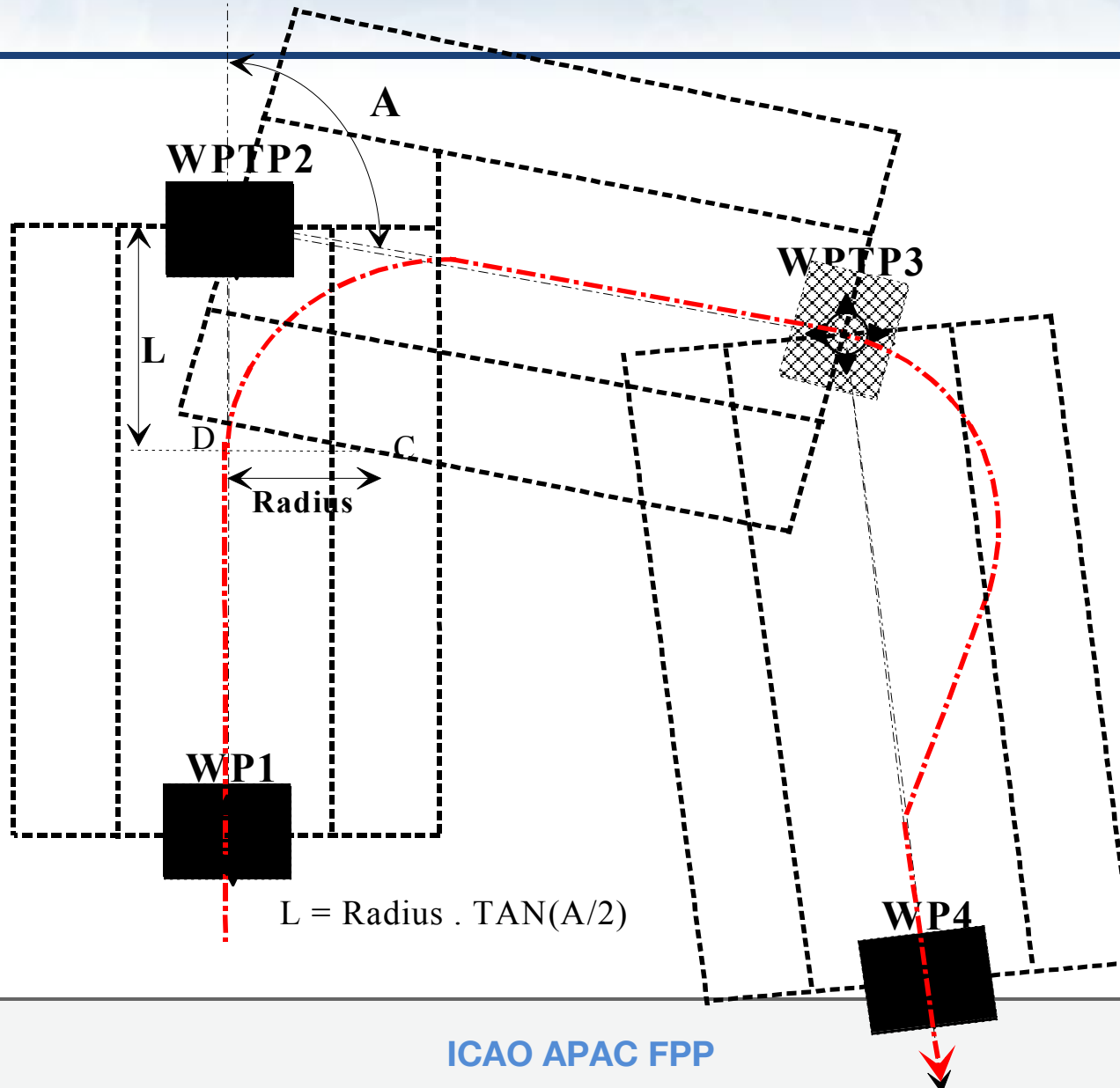


$$KK' = - ATT - r \tan(A/2)$$

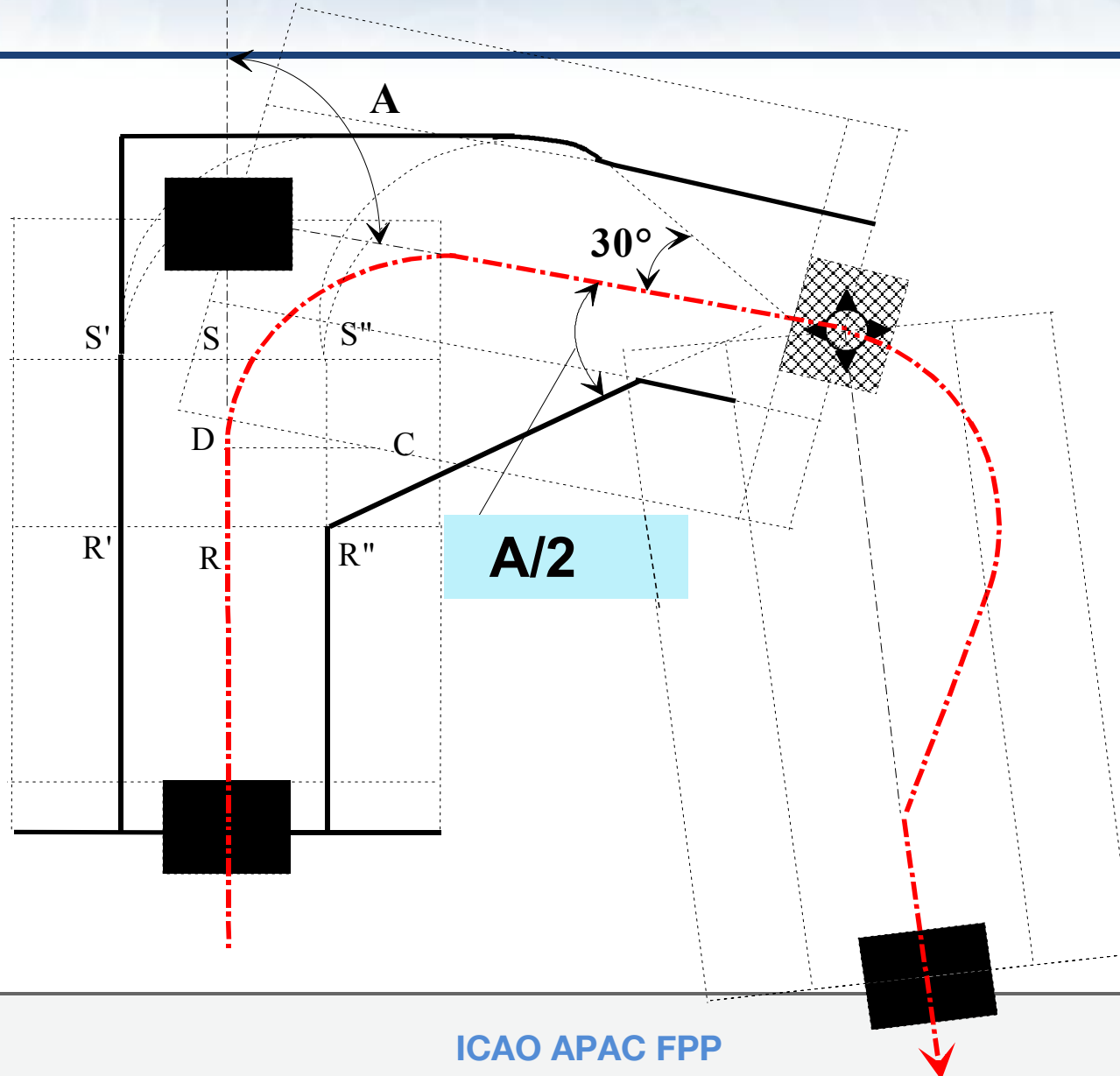
$$SS' = + ATT + C - r$$

C : pilot reaction

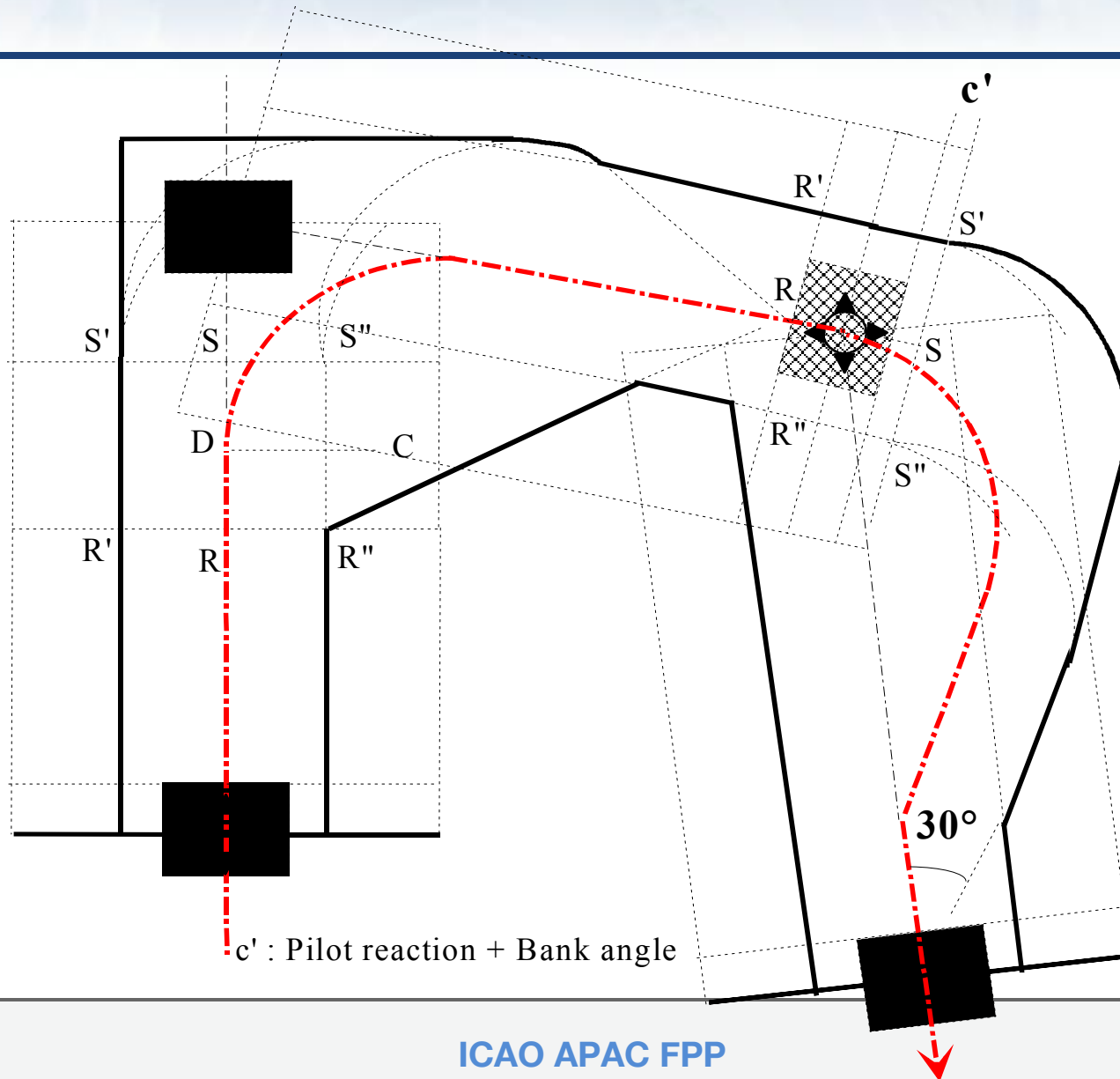
TF : PROTECTION AREA



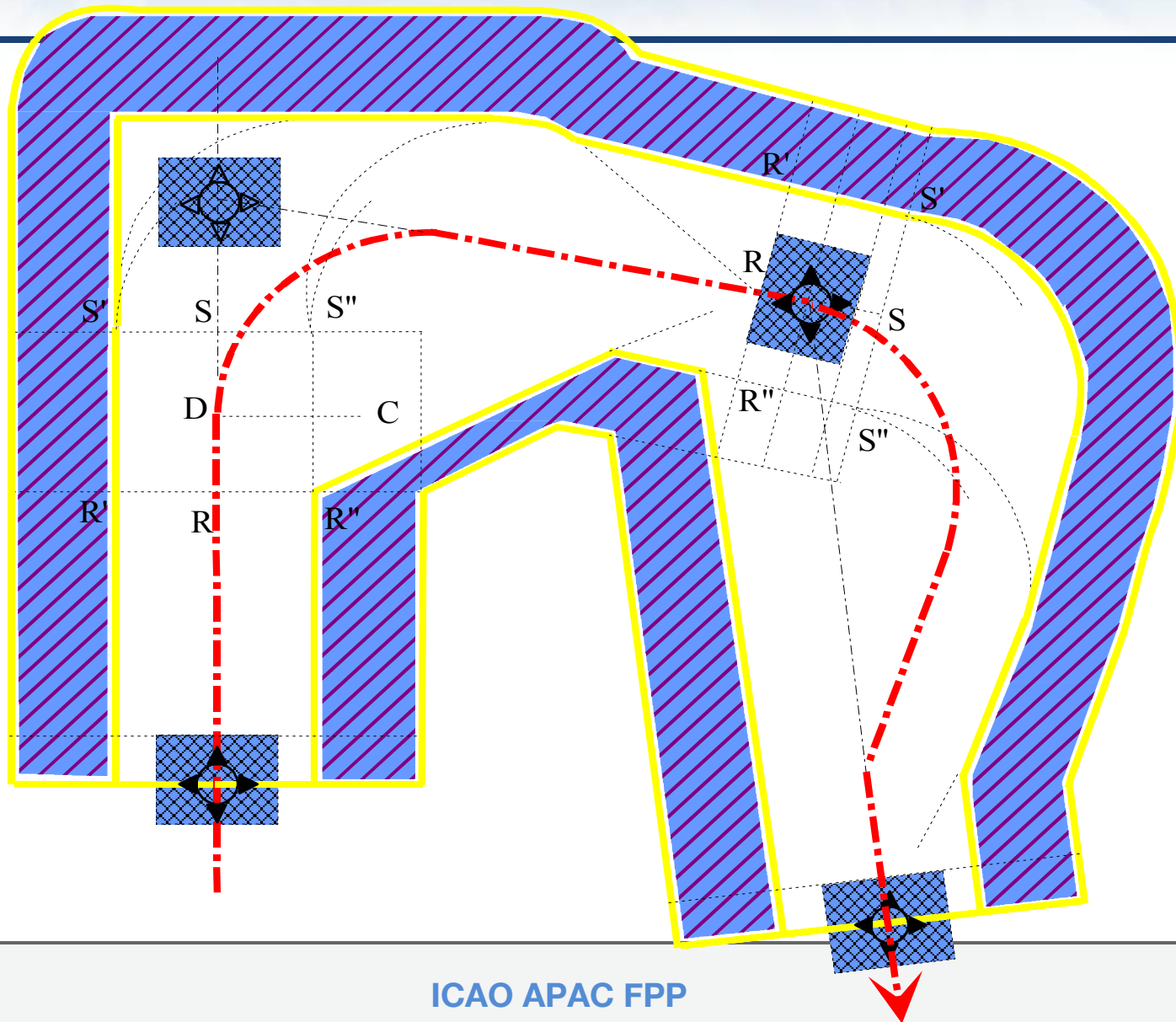
TF : PROTECTION AREA



TF : PROTECTION AREA



TF : PROTECTION AREA



- For protection of turn at **Fly by** waypoint accommodate **low speed** with **tangent to spiral**
- For **latest** turning point determination at **Fly by** waypoint, to accommodate **low speed** , turn initiation distance = $\min [r \tan A/2 , r]$

PROTECTION OF TURN AT IAF OR IF LESS OR EQUAL TO 30 ° OR LESS OR EQUAL TO 10 ° AT FAF ARC method



CIRCULAR ARC METHOD



§ III-2-2.2

Used for turn less or equal to 30° for IAF and IF and less or equal to 10° at FAF

Any questions?

