CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

National Policy

ORDER
8260.42B CHG 2

Effective Date:
05/22/2020

SUBJ: United States Standard for Helicopter Area Navigation (RNAV)

1. Purpose. This change incorporates updated office identifications to reflect the current FAA organizational structure; while removing routing symbols/codes. Also, this change ensures all users have the most up-to-date information to reduce confusion with functional FAA structures. This order contains guidance that is pertinent to 14 CFR Part 97.

2. Who this change affects. This is an administrative editorial change only.

3. Where You Can Find This Change. You can find this change on the Directives Management System (DMS) Website: http://www.faa.gov/regulations_policies/orders_notices.

4. Explanation of Changes.

a. General. Throughout the document, updated office identifications to reflect the current FAA organizational structure; replaced with the appropriate organization title. Removed outdated/obsolete references.

b. Table of Contents. Updated reflecting the correct content.

c. Appendix B. Removed, the content from this appendix is now addressed in Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS).

d. Appendix C. Renamed to Appendix B.

PAGE CHANGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
CHG 1 (Cover pg. 1 and 2)	11/20/2012	CHG 1 (Cover pg. 1 and 2)	05/22/2020
iii (and iv)	11/20/2012	iii (and iv)	05/22/2020
1-1 (and 1-2)	11/20/2012	1-1 (and 1-2)	05/22/2020
2-5 and 2-6	03/10/2009	2-5 and 2-6	05/22/2020
8-11 and 8-12	11/20/2012	8-11 and 8-12	05/22/2020
A-1 and A-2	03/10/2009	A-1 and A-2	05/22/2020
B-1 through B-148	03/10/2009	B-1 through B-6	05/22/2020
C-1 and C-6	11/20/2012		

5. Distribution. This change is distributed electronically only.

ROBERT C CARTY Digitally signed by ROBERT C CARTY Date: 2020.05.22 12:53:02 -04'00'

Rick Domingo
Executive Director, Flight Standards Service

SUBJ: United States Standard for Helicopter Area Navigation (RNAV)

1. Purpose. This change incorporates new Helicopter Departure and Localizer Precision with Vertical (HLPV) criteria. Order 8260.42B contains criteria for the formulation, review, approval, and publication of area navigation (RNAV) helicopter instrument procedures based on Global Positioning System (GPS) and Wide Area Augmentation System (WAAS) navigation.

2. Audience. The primary audience for this Order is the Air Traffic Organization (ATO), Mission Support Services (MSS), Aeronautical Information Services, who has the responsibility to develop instrument flight procedures. The secondary audience includes the ATO Service Areas' Operational Support Group, Flight Procedures Team (OSG-FPT), ATO Flight Program Operations, and Flight Standards offices.

3. Where You Can Find This Change. You can find this order on the Directives Management System (DMS) Website: http://www.faa.gov/regulations_policies/orders_notices.

4. Explanation of Changes. Significant areas of new direction, guidance, policy, and criteria as follows:

Note: General. All references to FAA Orders 8260.52, United States Standard for Required Navigation Performance (RNP) Approach Procedures with Special Aircraft and Aircrew Authorization Required (SAAAR), and 8260.54A, The United States Standard for Area Navigation, are now found in FAA Order 8260.58, United States Standard for Performance Based Navigation (PBN) Instrument Procedure Design.

a. Table of Contents. Updated Table of Contents to coincide with the pages changed.

b. Chapter 1. Added further explanation regarding “automation” to include the use of the calculators embedded in this order and the geodetic calculator available on the Flight Procedures and Airspace Group (FPAG) web site, or CompSys 21 geodetic calculator available on the Aeronautical Information Services' web site, or Instrument Approach Procedure Automation/Instrument Procedures Development System (IAPA/IPDS), or other FPAG-approved geodetic calculator.

c. Chapter 2.

(1) Paragraph 2. Added use of "rounding."

(2) Paragraph 2b. Updated Mathematics Convention to include feet per nautical mile (fpnm).

d. Chapter 6. Added Helicopter Departure criteria. This chapter describes RNAV departure criteria describing a visual departure from a non-instrument flight rules (IFR) departure location to an Initial Departure Fix to join with the IFR portion of the departure. This includes both public and special departure criteria.

e. Chapter 8. Added Helicopter Localizer Precision with Vertical (HLPV) criteria. This chapter describes the development of the HLPV Approach to a Point in Space and the initial missed approach segment.

f. Appendix C. Added new definitions to support new criteria in chapters 6 and 8.

Original Signed by

John M. Allen
Director, Flight Standards Service

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
i thru ii	03/10/09	i thru iv	11/20/12
1-1 thru 1-2	03/10/09	1-1 thru 1-2	11/20/12
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NEW	N/A	8-1 thru 8-22	11/20/12
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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
National Policy

ORDER 8260.42B

Effective Date:
March 10, 2009

SUBJ: United States Standard for Helicopter Area Navigation (RNAV)

These criteria are the Federal Aviation Administration (FAA) standards for developing helicopter area navigation (RNAV) instrument procedure construction based on Global Positioning System (GPS). This revision adds definitions, changes procedure identification from GPS to RNAV, provides specific holding pattern leg lengths, helicopter en route criteria, decreases navigation system error tolerance for along-track distance in the terminal area, and adds departure criteria, minimums, and requirements. The types of final approaches have been revised. They are Instrument Flight Rules (IFR) to an IFR heliport, IFR to a Visual Flight Rules (VFR) heliport (Proceed Visually), Point-in-Space (PinS) approach (Proceed VFR), and IFR to Runways with separate criteria for each.

The first step to increase helicopter IFR utility is the development of helicopter RNAV instrument procedures. Ongoing testing and criteria development by the FAA for application of the Wide Area Augmentation System (WAAS) will provide the next major step. WAAS with its increased integrity and 3-dimensional (3D) approach capability will allow narrower route widths and approaches with vertical guidance (APV).

Original Signed by

John H. Allen
Director, Flight Standards Service

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Initiated By: AFS-420

RECORD OF CHANGES

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL USE	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL USE

Table of Contents

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Chapter 1. General Information

1. Purpose of This Order. This order contains criteria for the formulation, review, approval, and publication of area navigation (RNAV) helicopter instrument procedures based on Global Positioning System (GPS) and Wide Area Augmentation System (WAAS) navigation.

2. Audience. This order is distributed in Airport Safety, Standards and Communications, and Navigation and Surveillance Systems; Air Traffic Organization; Flight Standards Services offices, and Airports Divisions; special mailing list ZVS-827, and Special Military and Public Addressees.

3. Where Can I Find This Order? This information is also available on the FAA's Web site at http://www.faa.gov/regulations_policies/orders_notices

4. What This Order Cancels. Order 8260.42A, Helicopter Global Positioning System (GPS) Nonprecision Approach Criteria.

5. Explanation of Policy Changes. This document has been completely revised for harmonization with FAA Order 8260.54, The United States Standard for Area Navigation (RNAV), incorporation of criteria policy documents, and to meet FAA Order 1320.1, FAA Directives Management, formatting requirements. These criteria were written for automated implementation through the use of the calculators embedded in the document, Flight Procedures and Airspace Group (FPAG) geodetic calculator, Compsys 21 geodetic calculator, Instrument Approach Procedure Automation/Instrument Procedures Development System (IAPA/IPDS), or other FPAG-approved geodetic calculation products. Formulas are presented in Math notation and standard text to facilitate programming efforts. Calculation examples were eliminated. Instead, an Adobe Acrobat version of the criteria document is available where each formula performs the calculation as an embedded calculator.

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Chapter 2. General Criteria

Section 1. Basic Criteria Information

2-1. General. These criteria assume use of Global Positioning System (GPS) or Wide Area Augmentation System (WAAS) receivers approved for approach operations, in accordance with Advisory Circular (AC) 20-138, Airworthiness Approval of Global Navigation Satellite System (GNSS) Equipment; Technical Standard Order (TSO) C-129 Class A (1) systems; and AC 20-130, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, for GPS as part of a multi-sensor system meeting TSO-C129 Class C (1) System or pertinent military guidance. Advisory Circular (AC) 20-138C, Airworthiness Approval of Positioning and Navigation Systems, and Technical Standard Order (TSO) C196A, Airborne Supplemental Navigation Sensors for Global Positioning System Equipment using Aircraft-Based Augmentation, contain updated Airworthiness guidance. WAAS navigation equipment must be approved in accordance with the requirements specified in TSO-C145, Airborne Navigation Sensors Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS), or TSO-C146, Stand-Alone Airborne Navigation Equipment Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS).

Unless otherwise specified, Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS), applies. For public use procedures, the heliport must meet the guidance contained in AC 150/5390-2, Heliport Design. Obstacle clearance area dimensions are based on 90 knots indicated airspeed (KIAS) maximum in the initial and intermediate segments and 70 KIAS maximum in the final and missed approach segments until passing the missed approach holding fix. USA/USAF/USN/USCG only: procedures are designed for 90 KIAS in the final and missed approach segments.

The following FAA orders apply:

- 7130.3, Holding Pattern Criteria.
- 8260.3, United States Standard for Terminal Instrument Procedures (TERPS).
- 8260.19, Flight Procedures and Airspace.

Apply chapter 2, section 3 of Order 7130.3, Holding Pattern Criteria. Use pattern 4 for all helicopter holding (including climb-in-hold) up to and including 10,000 ft. Chart 4 nautical mile (NM) leg lengths.

The feeder, initial, intermediate, final, and missed approach criteria described in this order supersede the other publications listed above. See Order 8260.3, Volume 1, chapter 3 to determine visibility minima.

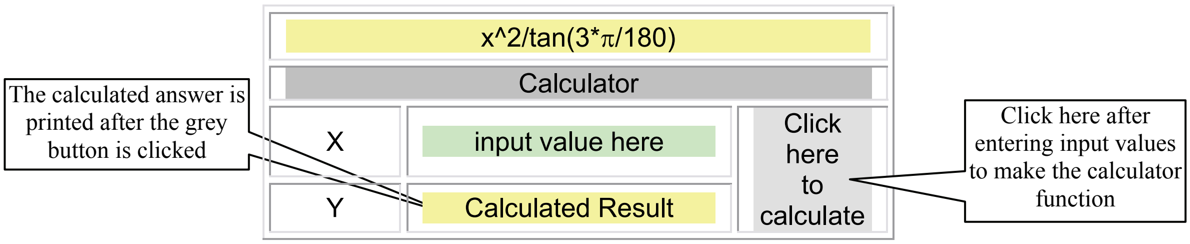
Formulas are numbered by chapter and depicted in standard mathematical notation and in standard text to aid in computer programming. Each formula contains a java script functional calculator.

Formula X-X. Formula Title

$$Y = \frac{X^2}{\tan\left(3 \cdot \frac{\pi}{180}\right)}$$

Formula in math notation

where X = variable value



2-2. Data Resolution. Perform calculations using an accuracy of at least 15 significant digits; i.e., floating point numbers must be stored using at least 64 bits. Unless otherwise noted, do not round intermediate results. Round only the final result of calculations for documentation purposes. Required accuracy tolerance is 1 centimeter for distance and 0.002 arc-second for angles. The following list specifies the minimum accuracy standard for documenting data expressed numerically. This standard applies to the documentation of final results only; e.g., a calculated adjusted glidepath angle of 3.04178 degrees is documented as 3.05 degrees. The standard does not apply to the use of variable values during calculation. Use the most accurate data available for variable values.

a. Documentation Accuracy:

(1) WGS-84 latitudes and longitudes to the nearest one hundredth (0.01) arc second; [nearest five ten thousandth (0.0005) arc second for Final Approach Segment (FAS) data block entries];

(2) Flight Path Alignment Point (FPAP) mean sea level (MSL) elevation to the nearest foot;

(3) FPAP height above ellipsoid (HAE) to the nearest tenth (0.1) meter;

(4) Glidepath angle to the next higher one hundredth (0.01) degree;

(5) Courses to the nearest one hundredth (0.01) degree;

(6) Course width at threshold to the nearest quarter (0.25) meter; and

(7) Distances to the nearest hundredth (0.01) unit [except for "length of offset" entry in FAS data block which is to the nearest 8 meter value].

b. Mathematics Convention. Formulas in this document as depicted are written for radian calculation.

Note: The value for 1 NM was previously defined as 6,076.11548 ft. For the purposes of RNAV criteria, 1 NM is defined as the result of the following calculation:

$$fpnm = \frac{1852}{0.3048}$$

(1) Conversions:

- Degree measure to radian measure:
  $radians = degrees \cdot \frac{\pi}{180}$

- Radian measure to degree measure:
  $degrees = radians \cdot \frac{180}{\pi}$

- Feet to meters:
  $meters = feet \cdot 0.3048$

- Meters to feet:
  $feet = \frac{meters}{0.3048}$

- Feet to Nautical Miles (NM):
  $NM = feet \cdot \frac{0.3048}{1852}$

- NM to feet:
  $feet = NM \cdot \frac{1852}{0.3048}$

- NM to meters:
  $meters = NM \cdot 1852$

- Meters to NM:
  $NM = \frac{meters}{1852}$

- Temperature Celsius to Fahrenheit:
  $T_{Fahrenheit} = 1.8 \cdot T_{Celcius} + 32$

- Temperature Fahrenheit to Celsius:
  $T_{Celcius} = \frac{T_{Fahrenheit} - 32}{1.8}$

(2) Definition of Mathematical Functions and Constants:

$a+b$ indicates addition

$a-b$ indicates subtraction

$a \times b$ or ab or $a*b$ or $a \cdot b$ indicates multiplication

$\frac{a}{b}$ or $^{a}\!/_{b}$ or $a \div b$ indicates division

$(a-b)$ indicates the result of the process within the parenthesis

$|a-b|$ indicates absolute value

$\approx$ indicates approximate equality

$\sqrt{a}$ or $a^{0.5}$ or a^0.5 indicates the square root of quantity "a"

a^2 or a^2 indicates $a \times a$

In(a) or log(a) indicates the natural logarithm of "a"

tan(a) indicates the tangent of "a" degrees

$\tan^{-1}(a)$ or atan(a) indicates the arc tangent of "a"

sin(a) indicates the sine of "a" degrees

$\sin^{-1}(a)$ or asin(a) indicates the arc sine of "a"

cos(a) indicates the cosine of "a" degrees

$\cos^{-1}(a)$ or acos(a) indicates the arc cosine of "a"

e The constant e is the base of the natural logarithm and is sometimes known as Napier's constant, although its symbol (e) honors Euler. With the possible exception of π, e is the most important constant in mathematics since it appears in myriad mathematical contexts involving limits and derivatives. Its value is approximately 2.71828182845904523536028747135266249775 7...

r The TERPS constant for the mean radius of the earth for spherical calculations in feet. r = 20890537

(3) Operation Precedence (Order of Operations):

First: Grouping Symbols: parentheses, brackets, braces, fraction bars, etc.
Second: Functions: Tangent, sine, cosine, arcsine, and other defined functions
Third: Exponentiations: Powers and roots
Fourth: Multiplication and Division: Products and quotients
Fifth: Addition and subtraction: Sums and differences
e.g.,
$5 - 3 \times 2 = -1$ because multiplication takes precedence over subtraction
$(5 - 3) \times 2 = 4$ because parentheses take precedence over multiplication
$\frac{6^2}{3} = 12$ because exponentiation takes precedence over division
$\sqrt{9+16} = 5$ because the square root sign is a grouping symbol
$\sqrt{9} + \sqrt{16} = 7$ because roots take precedence over addition

$\frac{\sin(30°)}{0.5} = 1$ because functions take precedence over division

$\sin\left(\frac{30°}{0.5}\right) = 0.8660254$ because parentheses take precedence over functions

Notes on calculator usage:

1. Most calculators are programmed with these rules of precedence.

2. When possible, let the calculator maintain all of the available digits of a number in memory rather than re-entering a rounded number. For highest accuracy from a calculator, any rounding that is necessary should be done at the latest opportunity.

c. Geospatial Standards. The following standards apply to the evaluation of obstacle and terrain position and elevation data relative to RNAV OEAs and OCSs. Terrain and obstacle data are reported in NAD-83 latitude, longitude, and elevation relative to MSL in National Geodetic Vertical Datum of 1929 (NGVD-29) or North American Vertical Datum of 1988 (NAVD-88) vertical datum. Evaluate obstacles using their NAD-83 horizontal position and NAVD-88 elevation value compared to the WGS-84 referenced course centerline (along-track and cross-track), OEA boundaries, and OCS elevations as appropriate.

(1) WGS-84[G873] for Position and Course Construction. This reference frame is used by the FAA and the U.S. Department of Defense (DoD). It is defined by the National Geospatial-Intelligence Agency (NGA) (formerly the National Imagery and Mapping Agency, formerly the Defense Mapping Agency [DMA]). In 1986, the Office of National Geodetic Survey (NGS), redefined and readjusted the North American Datum of 1927 (NAD-27), creating the North American Datum of 1983 (NAD-83). The WGS-84 was defined by the DMA. Both NAD-83 and WGS-84 were originally defined (in words) to be geocentric and oriented as the Bureau International d I'Heure (BIH) Terrestrial System. In principle, the three-dimensional (3D) coordinates of a single physical point should be the same in both NAD-83 and WGS-84 Systems; in practice; however, small differences are sometimes found. The original intent was that both systems would use the Geodetic Reference System of 1980 (GRS-80) as a reference ellipsoid. As it happened, the WGS-84 ellipsoid differs very slightly from GRS-80. The difference is 0.0001 meters in the semi-minor axis. In January 2, 1994, the WGS-84 reference system was realigned to be compatible with the International Earth Rotation Service's Terrestrial Reference Frame of 1992 (ITRF) and renamed WGS-84 (G730). The reference system underwent subsequent improvements in 1996, referenced as WGS-84 (G873) closely aligned with ITRF-94, to the current realization adopted by the NGA in 2001, referenced as WGS-84 (G1150) and considered equivalent systems to ITRF 2000.

(2) NAVD-88 for elevation values. NAVD-88 is the vertical control datum established in 1991 by the minimum-constraint adjustment of the Canadian-Mexican-U.S. leveling observations. It held fixed the height of the primary tidal bench mark, referenced to the new International Great Lakes Datum of 1985 local MSL height value, at Father Point/Rimouski, Quebec, Canada. Additional tidal bench mark elevations were not used due to the demonstrated variations in sea surface topography, (i.e., the fact that MSL is not the same equipotential surface at all tidal bench marks).

d. OEA Construction and Obstacle Evaluation Methodology.

(1) Courses, fixes, boundaries (lateral dimension). Construct straight-line courses as a WGS-84 ellipsoid geodesic path. If the course outbound from a fix differs from the course inbound to the fix (courses measured at the fix), then a turn is indicated. Construct parallel and trapezoidal boundary lines as a locus of points measured perpendicular to the geodesic path. (The resulting primary and/or secondary boundary lines do not display a "middle bulge" due to curvature of the ellipsoids surface since they are not geodesic paths.) NAD-83 latitude/longitude positions are acceptable for obstacle, terrain, and airport data evaluation. Determine obstacle lateral positions relative to course centerline/OEA boundaries using ellipsoidal calculations (see Order 8260.3).

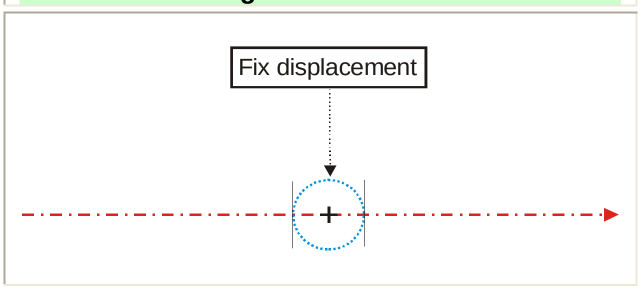
(2) Elevations (vertical dimension). Evaluate obstacles, terrain, and airport data using their elevation relative to their orthometric height above the geoid (for our purposes, MSL) referenced to the NAVD-88 vertical datum. The elevations of OCSs are determined spherically relative to their origin MSL elevation (NAVD-88). Department of Defense (DoD) procedure developers may use EGM-96 vertical datum.

e. Evaluation of Actual and Assumed Obstacles (AAO). Apply the vertical and horizontal accuracy standards in Order 8260.19, paragraphs 272, 273, 274, and appendix 3. (USAF, apply guidance per AFI 11-230)

Note: When applying an assumed canopy height consistent with local area vegetation, contact the designated Flight Procedures Team (FPT) to verify the height value to use.

f. ATT Values. ATT is the value used (for segment construction purposes) to quantify position uncertainty of an RNAV fix. The application of ATT can; therefore, be considered "circular;" i.e., the ATT value assigned describes a radius around the plotted position of the RNAV fix (see figure 2-1 and table 2-1).

Figure 2-1. ATT.



Note: Cross-track tolerance (XTT) values were considered in determining minimum segment widths, and are not considered further in segment construction.

Table 2-1. ATT Values.		
GPS	**En Route** Feeder, Initial, Intermediate, Missed Approach > 30 NM)	2.0 NM
	Terminal Feeder, Initial, Intermediate, Missed Approach ≤ 30 NM)	1.0 NM
	Approach (final)	0.3 NM
WAAS* (LP)	**Approach** (final)	40 meters

*Applies to final segment only. Apply GPS values to all other segments of the approach procedure.

3. Procedure Identification. GPS and WAAS are considered to be RNAV systems. The procedure identification begins with "COPTER RNAV (GPS)." The remainder of the identification is based on whether the landing site is a heliport or a runway.

a. U.S. Army (USA) Helicopter Runways. USA heliports that have helicopter runways chart the procedure with the letter H and the runway number. To differentiate between parallel runways, use the letter "L" or "R"; i.e., COPTER RNAV (GPS) RWY H22R.

b. IFR Approach to an IFR Runway (within 30 degrees alignment). Use the abbreviation "RWY" followed by the runway number. Examples: COPTER RNAV (GPS) RWY 22.

c. Point-in-Space (PinS) or IVH procedures to a VFR Runway. Use the magnetic bearing of the final approach course. Example: COPTER RNAV (GPS) 160°.

d. Multiple Procedures to the Same Runway. Where more than one approach, using the same final approach guidance is developed to the same location, identify each location/guidance combination with an alphabetical suffix beginning at the end of the alphabet; e.g., COPTER RNAV (GPS) Z RWY 22 (first procedure), COPTER RNAV (GPS) Y RWY 22 (second procedure), COPTER RNAV (GPS) X RWY 22 (third procedure). Identify the procedure with the lowest minimums will be identified with "Z" and the next lowest "Y."

e. Special Approach Procedures. A procedure requires special authorization when it is an instrument flight rules (IFR) approach to a visual flight rules (VFR) heliport, reference chapter 4, paragraph 5, or one of the following conditions exists: (USAF/USA/USCG/USN not applicable).

(1) A track change at the precise final approach fix (PFAF) exceeds 30 degrees.

(2) Descent Gradient/Angle exceeds 600 ft/NM (5.64 degrees) on any IFR segment.

(3) When raising the helipoint crossing height (HCH) to greater than 10 ft in the visual segment.

(4) When a V_{mini} less than 70 knots indicated airspeed (KIAS) is applied.

(5) Where a bank angle other than the standard is used.

(6) When the missed approach point (MAP) to helipoint distance is less than 3,342 ft (0.55 NM).

Note: This criterion applies only to an IFR to a VFR heliport (IVH) procedure.

4. Segment Width (General). Table 2-2 lists primary and secondary width values for all segments of an RNAV approach procedure. Where segments cross* a point 30 NM from airport reference point (HRP), segment primary area width increases (expansion) or decreases (taper) at a rate of 30 degrees relative to course to the appropriate width. Secondary area expansion/taper is a straight-line connection from the point the primary area begins expansion/taper to the point the primary area expansion/taper ends. Reference to route width values is often specified as NM values measured from secondary area edge across the primary area to the secondary edge at the other side. For example, route width for segments more than 30 NM from HRP is “1-3-3-1.” See figures 2-2b and 2-2c. For distances ≤ 30 NM, the width is “0.5-1.5-1.5-0.5.” See table 2-2 and figure 2-2a.

***Note:** Feeder segment width is 1-3-3-1 at all distances greater than 30 NM from HRP. A segment designed to cross within 30 NM of the HRP more than once does not taper in width until the 30 NM limit is crossed for approach and landing; i.e., crosses the limit for the last time before landing. A missed approach segment designed to cross a point 30 NM of the HRP more than once expands when it crosses the boundary the first time and remains expanded.

Table 2-2. RNAV Linear Segment Width (NM) Values.

Segment		Primary Area Half-Width (p)	Secondary Area (s)
En Route, Feeder, Initial & Missed Approach	> 30 NM from ARP	± 3.00	1.00
		1-3-3-1	
Feeder, Initial, Missed Approach	≤ 30 NM from ARP	± 1.50	0.5
		0.5-1.5-1.5-0.5	
Intermediate		Continues initial segment width until 2 NM prior to PFAF. Then tapers uniformly to final segment width.	Continues initial segment width until 2 NM prior to PFAF. Then tapers to final segment width.

Figure 2-2a. Segment Width Variables.

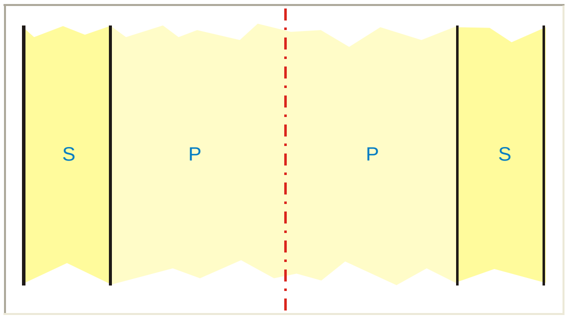


Figure 2-2b. En Route/Feeder/Initial Segment Cross Section (> 30 NM).

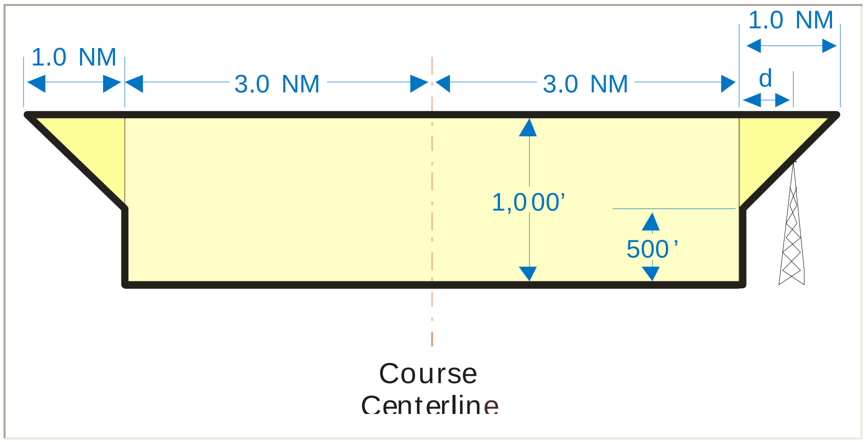
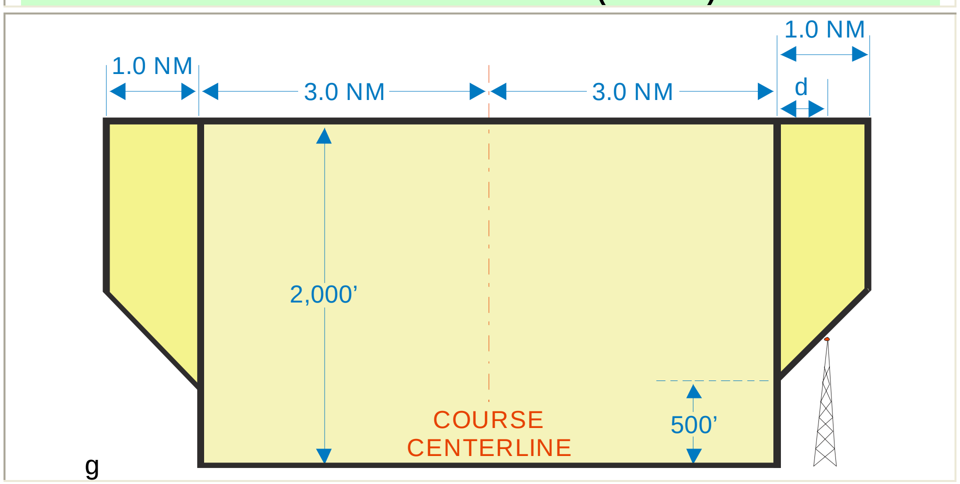


Figure 2-2c. En Route/Feeder/Initial Segment Cross Section Mountainous (> 30 NM).

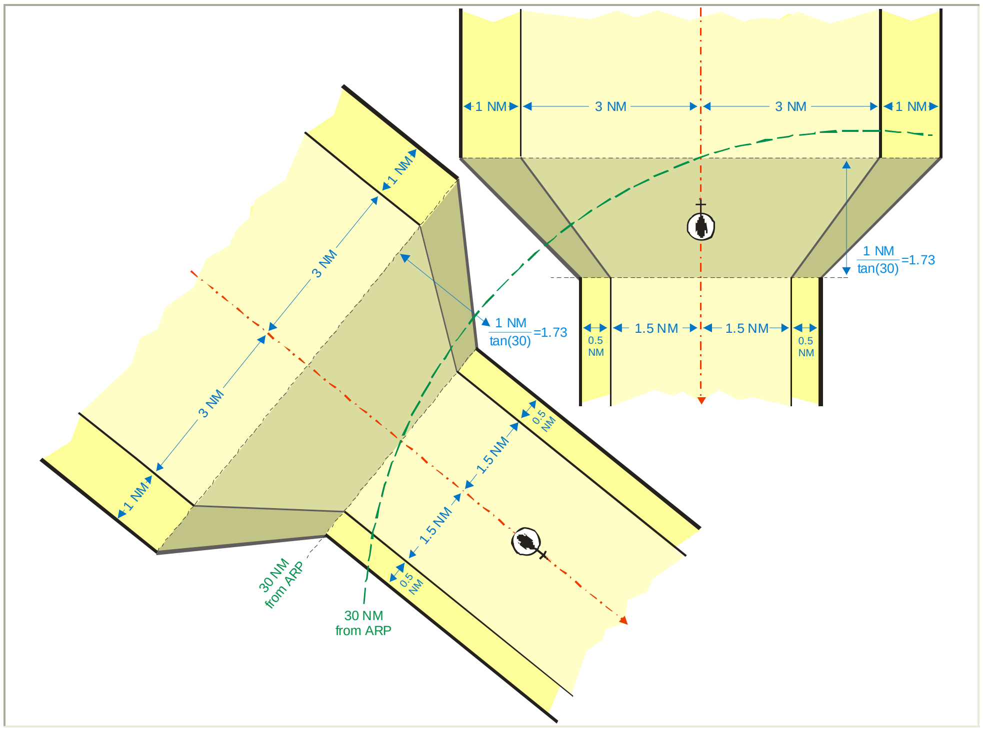


a. Width Changes at 30 NM from HRP/ARP.

(1) Width Changes at 30 NM from HRP (non-RF). Receiver sensitivity changes at 30 NM from HRP. From the point the designed course crosses 30 NM from HRP, the primary

OEA can taper inward at a rate of 30 degrees relative to course from ± 3 NM to ± 1.5 NM. The secondary area tapers from a 1 NM width when the 30 NM point is crossed to a 0.5 NM width abeam the point the primary area reaches the ± 1.5 NM width. The total along-track distance required to complete the taper is approximately 1.73 NM (10,524.14 ft). Segment width tapers regardless of fix location within the tapering section unless a turn is associated with the fix. Delay OEA taper until the turn is complete and normal OEA turn construction is possible (see figure 2-3a).

Figure 2-3a. Segment Width Changes at 30 NM.



(2) Width Changes at 30 NM from HRP/ARP (RF). When the approach segment crosses the point 30 NM from airport reference point in an RF leg, construct the leg beginning at a width of 1-3-3-1 prior to the 30 NM point and taper to 0.5-1.5-1.5-0.5 NM width inside the 30 NM point. Calculate the perpendicular distance ($B_{primary}$, $B_{secondary}$) from the RF segment track centerline to primary and secondary boundaries at any along-track distance (specified as degrees of RF arc "α") from the point the track crosses the 30 NM point using formula 2-1 (see figure 2-3b, apply formula 2-3c to find the RF arc radius).

Formula 2-1. RF Segment Taper Width.

$$D=\frac{3\text{-}1.5}{\tan\left(30\cdot\frac{\pi}{180}\right)} \qquad \alpha=\frac{180\cdot D}{\pi\cdot R}$$

Calculates degrees of arc (α) to complete taper

$$B_{primary}=3-1.5\cdot\frac{\phi\cdot\pi\cdot R}{180\cdot D}$$

$$B_{secondary}=4-2\cdot\frac{\phi\cdot\pi\cdot R}{180\cdot D}$$

Where:

D = taper distance
R = RF leg radius
ϕ = degrees of arc (RF track)

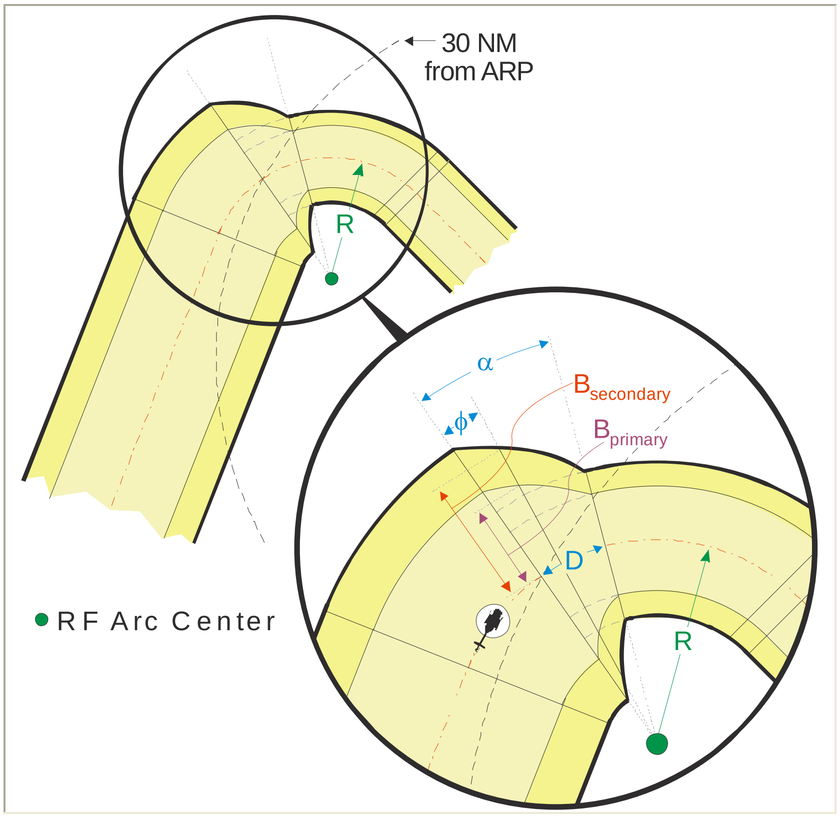
Note: "D" will be in the same units as "R"

D=(3-1.5)/tan(30*π/180)
α = (180*D)/(π*R)
$B_{primary}$ = 3-1.5*(ϕ*π*R)/(180*D)
$B_{secondary}$ = 4-2*(ϕ*π*R)/(180*D)

Calculator

R		Click here to calculate
ϕ	°	
α	°	
D		
$B_{primary}$		
$B_{secondary}$		

Figure 2-3b. Segment Width Changes in RF Leg.



5. Calculating the Turn Radius (R). The design turn radius value is based on four variables: indicated airspeed, assumed tailwind, altitude, and bank angle. Calculate R using formula 2-3c. Apply the indicated airspeed from table 2-3 for the highest speed helicopter category that will be published on the approach procedure. Apply the highest expected turn altitude value. Apply the appropriate bank angle from table 2-4 and formula 2-2 to determine the vertical path altitude (VP_{alt}).

Formula 2-2. Vertical Path Altitude.
$$VP_{alt} = e^{\frac{D_Z \cdot \tan\left(\theta \cdot \frac{\pi}{180}\right)}{r}} \cdot \left(r + PFAF_{alt}\right) - r$$ Where: $PFAF_{alt}$ = Designed PFAF MSL altitude θ = glidepath angle D_Z = distance (ft) from PFAF to fix   **Note:** If D_Z is a NM value, convert to feet by multiplying NM by 1852/0.3048
e^((D$_Z$*tan(θ*π/180))/r)*(r+PFAF$_{alt}$)-r
Calculator

$PFAF_{alt}$		Click here to calculate
θ	°	
D_Z		
VP_{alt}		

Note: Determine the highest altitude within a turn by:

For approach –calculate the vertical path altitude (VP_{alt}) by projecting a 3-degree vertical path from the PFAF along the designed nominal flight track to the turn fix.

For missed approach highest altitude in a turn, apply (a) or (b), and (c).

(a) Turn-At-A-Fix, project a vertical path along the nominal flight track from the SOC point and altitude to the turn fix, that rises at a rate of 400 ft/NM (Helicopter) or a higher rate if a steeper climb gradient is specified. Compare the vertical path altitude at the fix to the minimum published fix altitude, apply the higher of the two;

(b) Turn-At-An-Altitude, apply the climb-to-altitude;

(c) Plus an additive, (Turn-At-A-Fix (FO) and Turn-At-An-Altitude) based on a continuous climb of 400 ft per 12 degrees of turn [ϕ*400/12]). The turn altitude must not be higher than the published missed approach altitude.

Helicopter example: 900 ft would be added for a turn of 27 degrees, 767 ft would be added for 23 degrees, 333 ft for 10 degrees of turn.

Step 1: Determine the true airspeed (KTAS) for the turn using formula 2-3a. Locate and use the appropriate knots indicated airspeed (KIAS) from table 2-3. Use the highest altitude within the turn.

Formula 2-3a. True Airspeed.
$$V_{KTAS} = \frac{V_{KIAS} \cdot 171233 \cdot \sqrt{(288+15) - 0.00198 \cdot alt}}{(288 - 0.00198 \cdot alt)^{2.628}}$$ where alt = aircraft MSL elevation V_{KIAS} = knots indicated airspeed
(V_{KIAS}*171233*((288+15)-0.00198*alt)^0.5)/(288-0.00198*alt)^2.628

Calculator		
V_{KIAS}		Click here to calculate
alt		
V_{KTAS}		

Table 2-3. Helicopter Indicated Airspeeds (Knots).		
Segment	Indicated Airspeed	
	Civil	Military
Feeder, Initial, Intermediate	140	140
Final, Missed Approach	70	90

Step 2: Calculate the appropriate tailwind component (V_{KTW}) using formula 2-3b for the highest altitude within the turn. EXCEPTION: If the MSL altitude is 2,000 ft or less above airport elevation, use 30 knots.

Formula 2-3b. Tailwind.
$V_{KTW} = 0.00198 \cdot alt + 47$ where alt = highest turn altitude **Note:** If "alt" is 2,000 or less above airport elevation, then V_{KTW} = 30
0.00198*alt+47

Calculator		
alt		Click here to calculate
V_{KTW}		

Note: Greater tailwind component values may be used where data indicates higher wind conditions are likely to be encountered. Where a higher value is used, it must be recorded in the procedure documentation.

Step 3: Calculate R using formula 2-3c.

Formula 2-3c. Turn Radius.		
$$R = \frac{(V_{KTAS} + V_{KTW})^2}{\tan\left(bank_{angle} \cdot \frac{\pi}{180}\right) \cdot 68625.4}$$ where $bank_{angle}$ = assumed bank angle (normally 11° or 14° for Helicopter)		
$(V_{KTAS}+V_{KTW})$^2/(tan($bank_{angle}$*π/180)*68625.4)		
Calculator		
V_{KTAS}		Click here to calculate
V_{KTW}		
$bank_{angle}$	°	
R		

Note: Use formula 2-8 to verify the required bank angle does not exceed the design bank angle (11 or 14 degrees), see table 2-4.

Table 2-4. Bank Angles.		
Knots True Airspeed (KTAS)	< 90	≥ 90
Bank Angle (In degrees)	11.0	14.0

6. Turn Construction. If the outbound course from a fix differs by more than 0.03 degrees from the inbound course to the fix (courses measured at the fix), a turn is indicated.

a. Turns at Fly-Over Fixes (see figures 2-4 and 2-5)**.**

(1) Extension for Turn Delay. Turn construction incorporates a delay in start of turn to account for pilot reaction time and roll-in time (rr). Calculate the extension distance in feet using formula 2-4a (terminal) or formula 2-4b (feeder and en route).

Formula 2-4a. Reaction & Roll Dist. (Terminal).		
$rr = 6 \cdot \frac{\frac{1852}{0.3048}}{3600} \cdot V_{KTAS}$		
$6*1852/0.3048/3600*V_{KTAS}$		
Calculator		
V_{KTAS}		Click here to calculate
rr		

Note: 6 second delay

Formula 2-4b. Turn Delay (En Route, Feeder).		
$rr=8 \cdot \frac{\frac{1852}{0.3048}}{3600} \cdot (V_{KTAS}+V_{KTW})$		
$8*(1852/0.3048/3600)*(V_{KTW}+V_{KTAS})$		
Calculator		
V_{KTW}		Click here to calculate
V_{KTAS}		
rr (ft)		

Note: 8 second delay

Step 1: Determine **R**. See formula 2-3c.

Step 2: Determine **rr**. See formula 2-4a or formula 2-4b.

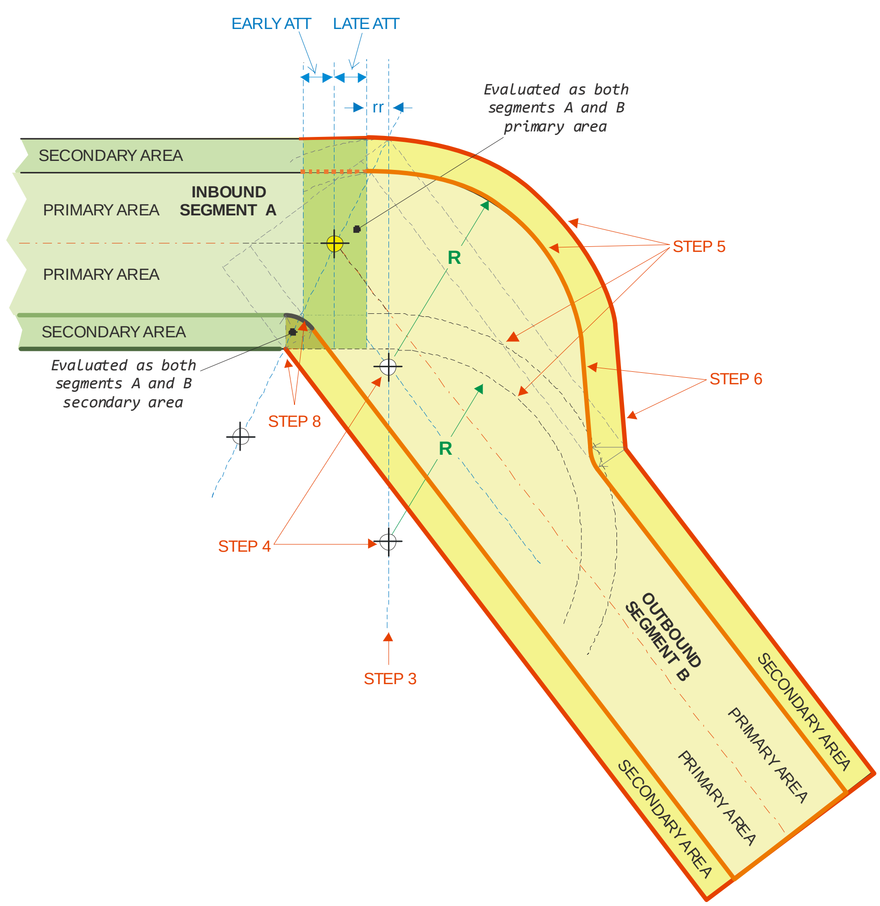
Step 3: Establish the baseline for construction of the turn expansion area as the line perpendicular to the inbound track at a distance past the turn fix equal to (ATT+rr).

Step 4: On the baseline, locate the center points for the primary and secondary turn boundaries. The first is located at a distance R from the non-turning side primary boundary. The second is located at a distance R from the turning side secondary boundary (see figures 2-4 and 2-5).

Step 5: From these center points construct arcs for the primary boundary of radius R. Complete the secondary boundary by constructing additional arcs of radius ($R+W_S$) from the same center points. (W_S=width of the secondary). This is shown in figures 2-4 and 2-5.

Step 6: The arcs constructed in step 5 are tangent to the outer boundary lines of the inbound segment. Construct lines tangent to the arcs based on the first turn point tapering inward at an angle of 30 degrees relative to the outbound track that joins the arc primary and secondary boundaries. If both the inner and outer arcs lie outside subsequent segment boundary lines, but the resulting tapering line tangent points lie inside the subsequent segment boundary lines, consider the expanded boundary connection points to be the intersection of the arc and the subsequent segment boundary lines. If the arcs from the second turn point are inside the tapering lines as shown in figure 2-4, then they are disregarded and the expanded area construction is completed. If not, proceed to step 7.

Figure 2-4. Fly-Over with No Second Arc Expansion.

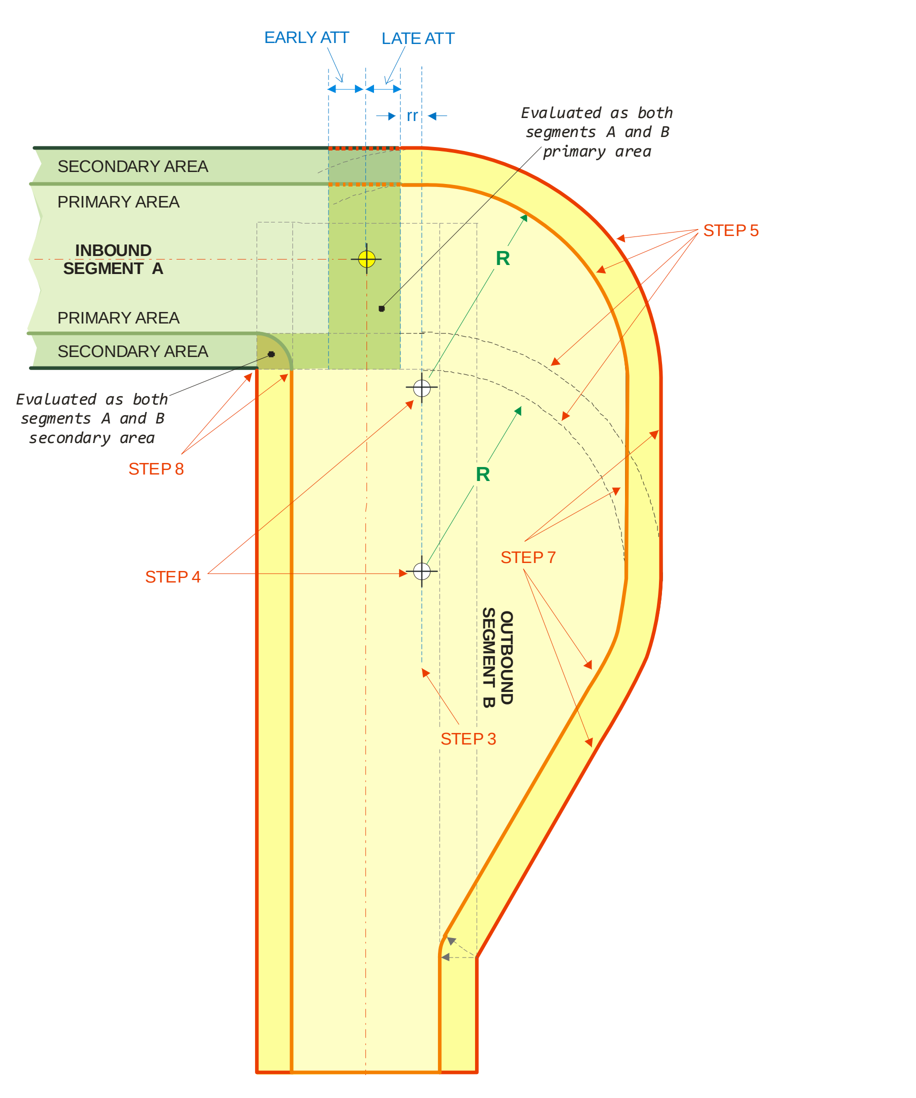


Step 7: If both the inner and outer arcs lie outside the tapering lines constructed in step 6, connect the respective inner and outer arcs with tangent lines and then construct the tapering lines from the arcs centered on the second center point as shown in figure 2-5.

Step 8: The inside turn secondary boundary is the intersection of the preceding and succeeding segment secondary boundaries. The inside turn primary boundary is an arc of secondary-width radius joining the preceding and succeeding segment primary boundaries.

Evaluate the inbound-segment secondary area truncated by the arc as primary area by both segments. Both segments also evaluate the secondary area inside the arc (see figures 2-4 and 2-5)

Figure 2-5. Fly-Over with Second Arc Expansion.



The inbound OEA end (± ATT) is evaluated for both inbound and outbound segments.

(2) Minimum length of TF leg following a fly-over turn. The leg length of a TF leg following a fly-over turn must be sufficient to allow the aircraft to return to course centerline. Determine the minimum leg length (L) using DTA distance from formula 2-5 and formula 2-6.

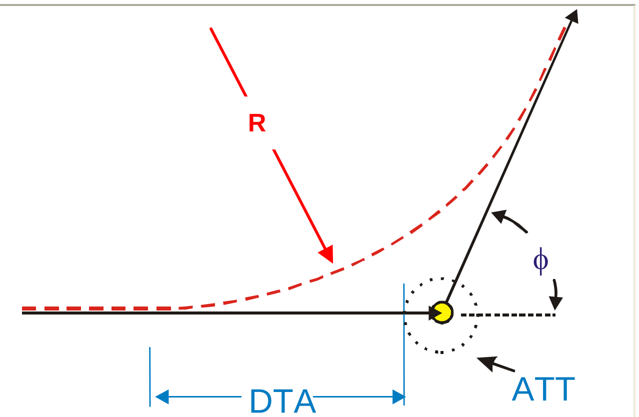
Formula 2-5. Distance of Turn Anticipation.

$$DTA = R \cdot \tan\left(\frac{\phi}{2} \cdot \frac{\pi}{180}\right)$$

Where:

R = turn radius from formula 2-3c

ϕ = degrees of heading change



R*tan(ϕ/2*π/180)

Calculator

R		Click here to calculate
ϕ	°	
DTA		

Formula 2-6. TF Leg Minimum Length Following Fly Over Turn.

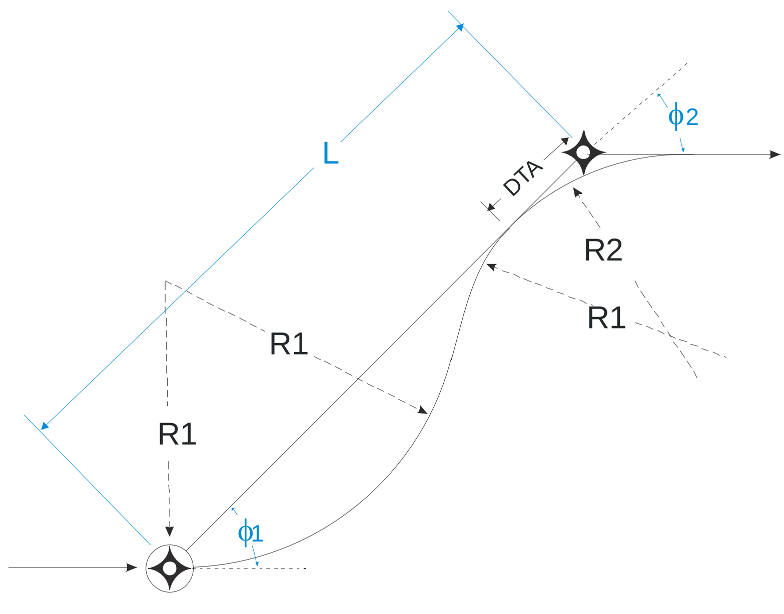
If $\phi 1 < \frac{180}{\pi} \cdot \operatorname{acos}(3^{0.5}-1)$, then

$$L = R1 \cdot \left(\sin(\phi 1) + 2 \cdot \sin\left(\operatorname{acos}\left(\frac{(1+\cos(\phi 1))}{2} \right) \right) \right) + R2 \cdot \tan\left(\frac{\phi 2}{2}\right)$$, else

$$L = R1 \cdot \left(\sin(\phi 1) + 4 - 3^{0.5} - 3^{0.5} \cdot \cos(\phi 1) \right) + R2 \cdot \tan\left(\frac{\phi 2}{2}\right)$$

Where:

R1 = turn radius (NM) at the segment initial fix (formula 2-3c)
R2 = turn radius (NM) at the segment termination fix (zero if no fly-by turn)
ϕ1 = turn magnitude at the segment initial fix
ϕ2 = turn magnitude at the segment termination fix



If ϕ1 <180/π*acos(3^0.5-1), then
R1*(sin(ϕ1*π/180)+2*sin(acos((1+cos(ϕ1*π/180))/2)))+R2*tan((ϕ2/2)*π/180), else
R1*(sin(ϕ1*π/180)+4-3^0.5-3^0.5*cos(ϕ1*π/180))+R2*tan((ϕ2/2)*π/180)

Calculator

R1		Click here to calculate
R2		
ϕ1	°	
ϕ2	°	
L		

b. Fly-By Turn. See figure 2-6.

Step 1: Establish a line through the turn fix that bisects the turn angle. Determine Turn Radius (R). See formula 2-3c. Scribe an arc (with origin on bisector line) of radius R tangent to inbound and outbound courses. This is the designed turning flight path.

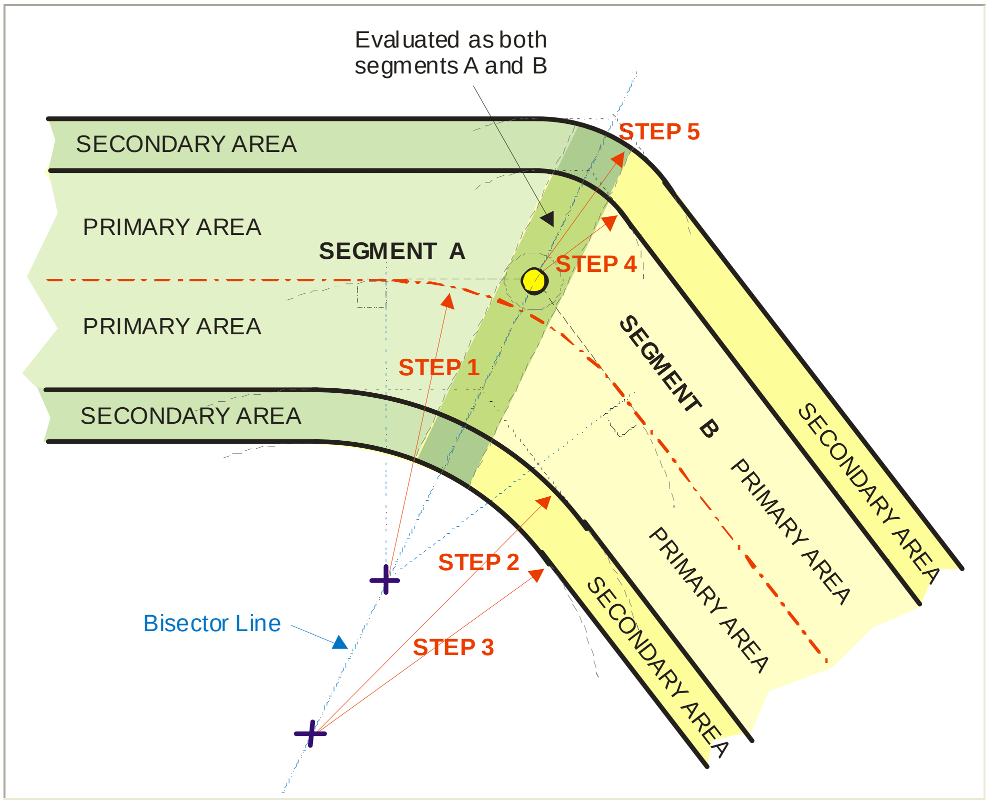
Step 2: Scribe an arc tangent to the inner primary boundaries of the two segment legs with a radius equal to $\mathbf{R}+\frac{\text{Primary Area Half-width}}{2}$ (example: half width of 2 NM, the radius would be R+1.0 NM).

Step 3: Scribe an arc that is tangent to the inner secondary boundaries of the two segment legs using the origin and radius from step 2 minus the secondary width.

Step 4: Scribe the primary area outer turning boundary with an arc with a radius equal to the segment half width centered on the turn fix.

Step 5: Scribe the secondary area outer turning boundary with the arc radius from step 4 plus the secondary area width centered on the turn fix.

Figure 2-6. Fly-By Turn Construction.



(1) Minimum length of track-to-fix (TF) leg following a fly-by turn. Calculate the minimum length for a TF leg following a fly-by turn using formula 2-7.

Formula 2-7. TF Leg Minimum Length Following Fly by Turn.

$$L = R1 \cdot \tan(\frac{\phi 1}{2}) + R2 \cdot (\frac{\phi 2}{2})$$

Where:

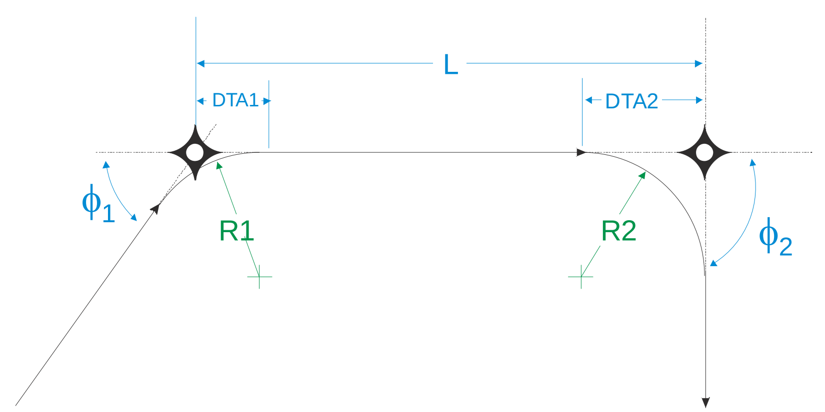
R1 = Turn radius at the segment initial fix (formula 2-3c)

R2 = Turn radius at the segment termination (formula 2-3c)

Note: Zero when no turn

ϕ_1 = turn magnitude at the segment initial fix

ϕ_2 = turn magnitude, if any at the segment termination fix



R1*tan(ϕ1/2*π/180)+R2*tan(ϕ2/2*π/180)

Calculator

R1		Click here to calculate
R2		
ϕ1	°	
ϕ2	°	
L		

c. Radius-to-Fix (RF) Turn. Incorporation of an RF segment may limit the number of aircraft served by the procedure. RF legs are used to control the ground track of a turn where obstructions prevent the design of a fly-by or fly-over turn, or to accommodate other operational requirements.* The curved leg begins tangent to the previous segment course at its terminating fix and ends tangent to the next segment course at its beginning fix (see figure 2-7). OEA construction limits turn radius to a minimum value equal-to or greater-than the OEA (primary and secondary) half-width. The RF segment OEA boundaries are parallel arcs.

> ***Note:** RF legs segments are not applicable to the final segment or section 1 of the missed approach segment. RF legs in the intermediate segment must terminate at least 2 NM prior to the PFAF. Where RF legs are used, annotate the procedure (or segment as appropriate) “RF Required.” Use Order 8260.52, table 1-3 for V_{KTW} values for radius calculations for RF legs.

Step 1: Determine the segment turn radius (R) that is required to fit the geometry of the terrain/airspace. Enter the required radius value into formula 2-8 to verify the resultant bank angle is ≤ 20 degrees (maximum allowable bank angle). Where a bank angle other than standard is used, annotate the value in the remarks section of the FAA Form 8260-9 or appropriate military procedure documentation form.

Formula 2-8. RF Bank Angle.

$$bank_{angle} = a\tan\left(\frac{(V_{KTAS}+V_{KTW})^2}{R\cdot 68625.4}\right)\cdot\frac{180}{\pi}$$

Where:

V_{KTAS} = value from formula 2-3a

V_{KTW} = value from Order 8260.52, table 1-3

R = required radius

atan((V_{KTAS}+V_{KTW})^2/(R*68625.4))*180/π

Calculator

V_{KTAS}		Click here to calculate
V_{KTW}		
R		
$bank_{angle}$	°	

Calculate RF segment length using formula 2-9.

Formula 2-9. RF Segment Length.		
$$Segment_{length} = \frac{\pi \cdot R \cdot \phi}{180}$$ Where: R = RF segment radius (answer will be in the units entered) ϕ = # of degrees of ARC (heading change)		
π*R*ϕ/180		
Calculator		
R		Click here to calculate
ϕ	°	
$Segment_{length}$		

Step 2: <u>Turn Center</u>. Locate the turn center at a perpendicular distance R from the preceding and following segments.

Step 3: <u>Flight path</u>. Construct an arc of radius R from the tangent point on the preceding course to the tangent point on the following course.

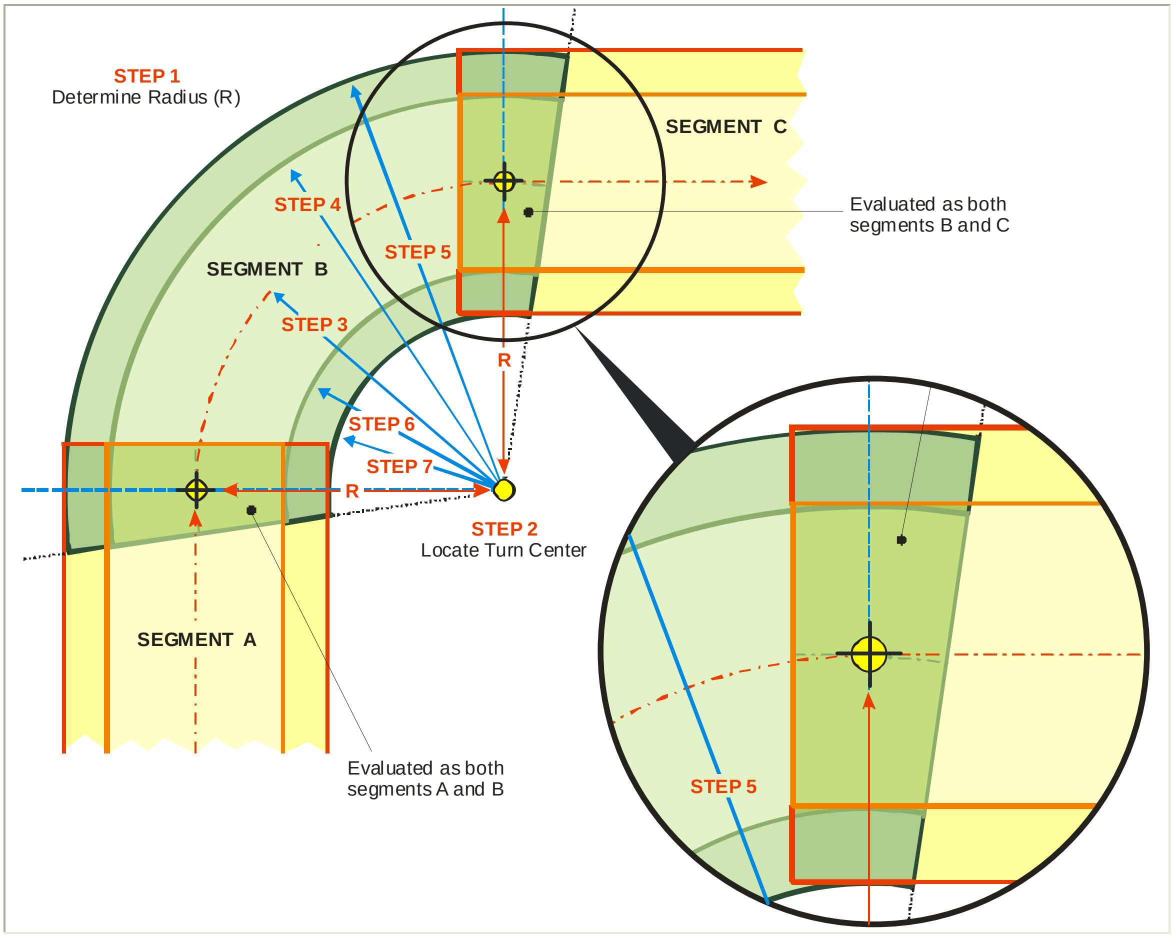
Step 4: <u>Primary area outer boundary</u>. Construct an arc of radius R+Primary area half-width from the tangent point on the preceding segment primary area outer boundary to the tangent point on the following course primary area outer boundary.

Step 5: <u>Secondary area outer boundary</u>. Construct an arc of radius R+Primary area half-width+secondary area width from the tangent point on the preceding segment secondary area outer boundary to the tangent point on the following course secondary area outer boundary.

Step 6: <u>Primary area inner boundary</u>. Construct an arc of radius R-Primary area half-width from the tangent point on the preceding segment inner primary area boundary to the tangent point on the following course inner primary area boundary.

Step 7: <u>Secondary area inner boundary</u>. Construct an arc of radius R-(Primary area half-width+secondary area width) from the tangent point on the preceding segment inner secondary area boundary to the tangent point on the following course inner secondary area boundary.

Figure 2-7. RF Turn Construction.



d. RNAV TF/VA/VI/CF leg followed by a DF Leg. Calculate minimum DF segment length using formula 2-9b.

Formula 2-9b. RNAV DF Leg Minimum Length following TF/VA/VI/CF Legs.

If $\phi > 30$ then

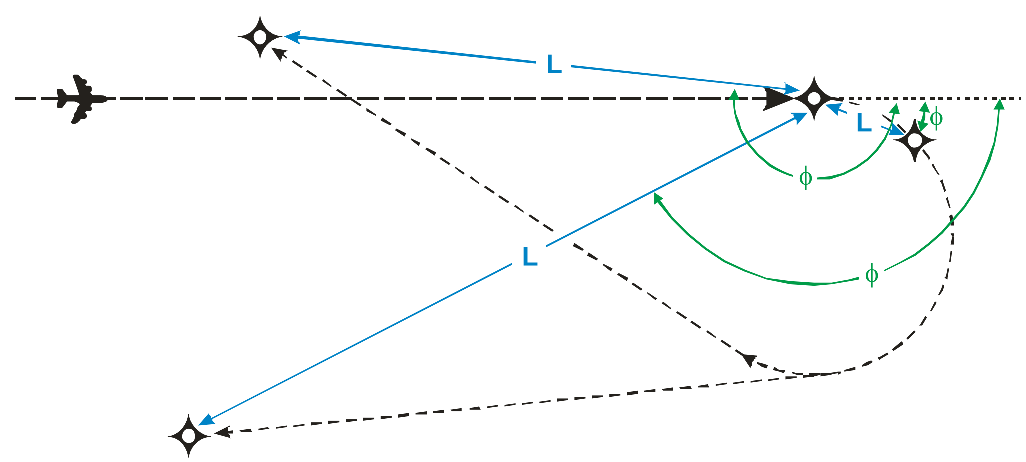
$$L = 4 \cdot R \cdot \left(\sin\left(\frac{\phi + 30}{2}\right)\right)^2, \text{ else}$$

$$L = 2 \cdot R \cdot \sin(\phi)$$

Where:

R = turn radius (NM) at the segment initial fix (formula 2-3c)

ϕ = turn magnitude at the segment initial fix



If ϕ>30 then
L= 4*R*(sin((ϕ+30)/2*π/180))^2, else
L=2*R*sin(ϕ*π/180)

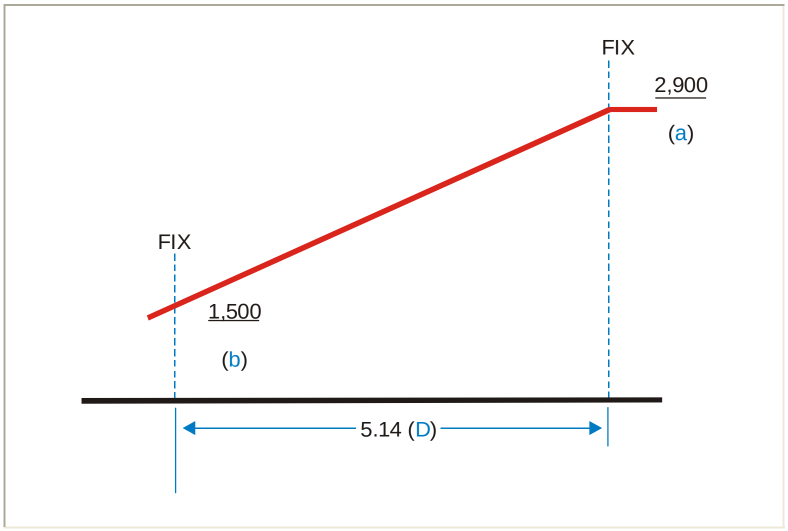
Calculator

R		Click here to calculate
ϕ		
L		

7. Helicopter Initial and Intermediate Descent Gradient. The optimum descent gradient in the initial and intermediate segment is 400 ft/NM (6.58%, 3.77°); maximum is 600 ft/NM (9.87%, 5.64°). Where higher descent gradients are required, Order 8260.3, Volume 1, paragraph 1110 applies.

a. Calculating Descent Gradient (DG). Determine total altitude lost between the plotted positions of the fixes. Determine the distance (D) in NM. Divide the total altitude lost by D to determine the segment descent gradient using formula 2-10 (see figure 2-8).

Figure 2-8. Calculating Descent Gradient.



Formula 2-10. Descent Gradient.

$$DG = \frac{r \cdot \ln\left(\frac{r+a}{r+b}\right)}{D}$$

Where:
a = beginning altitude
b = ending altitude
D = distance (NM) between fixes

r*ln((r+a)/(r+b))/D

Calculator

a		Click here to calculate
b		
D		
DG		

8. Feeder Segment. When the initial approach fix (IAF) is not part of the en route structure, it may be necessary to designate feeder routes from the en route structure to the IAF. The feeder segment may contain a sequence of TF segments (and/or RF segments). The maximum course change between TF segments is 90 degrees (70 degrees preferred). Formula 2-3c note applies. Chapter 2, paragraph 6 turn construction applies. The feeder segment terminates at the IAF (see chapter 2, figures 2-4, 2-5, and 2-6 for construction).

a. Length. The **minimum** length of a sub-segment is determined under chapter 2, paragraph 6a(2) or 6b(1) as appropriate. The **maximum** length of a sub-segment is 50 miles. The total length of the feeder segment should be as short as operationally possible.

b. Width. Primary area width is ± 3.0 NM from course centerline; secondary area width is 1.0 NM (1-3-3-1). These widths apply from the feeder segment initial fix to the approach IAF/termination fix.

c. Obstacle Clearance. The feeder segment OEA begins at the beginning fix early ATT and ends at the ending fix late ATT. The minimum ROC over areas not designated as mountainous under Federal Aviation Regulation (FAR) 95 is 1,000 ft. The minimum ROC within areas designated in FAR 95 as "mountainous" is 2,000 ft. Order 8260.3, Volume 1, paragraphs 1720b(1), 1720b(2), and 1721 apply. The published minimum feeder route altitude must provide at least the minimum ROC value and must not be less than the altitude established at the IAF. (Refer to figures 2-2a, 2-2b **and** apply formula 2-12a for standard secondary ROC.) Apply formula 2-12b for designated mountainous area calculations (formulas are applicable for en route, feeder, and initial).

Note: ROC additive, see 8260.3, Volume 1, paragraph 1720.

d. Descent Gradient, Helicopter (feeder, initial, intermediate segments)**.** The optimum descent gradient in feeder, initial, and intermediate segments is 400 ft/NM (6.58%, 3.77°); maximum is 600 ft/NM (9.87%, 5.64°). Where higher descent gradients are required, Order 8260.3, Volume 1, paragraph 1110 applies.

e. Minimum Crossing Altitude (MCA). Establish an MCA when an obstacle prevents a normal climb to a higher minimum en route altitude (MEA). The normal climb gradient is shown in table 2-5. When a MCA is required, chart the required climb gradient and rate of climb on the procedure.

Table 2-5. Normal Helicopter En Route Climb Gradient.

Gradient Level (MSL)	Gradient	OCS Slope
at or below 5,000 ft	300 ft per NM	20.25:1
5,001 ft through 10,000 ft	240 ft per NM	25.3:1

The MCA computation is based on the distance from the nearest fix displacement tolerance line to the obstacle. The computation is rounded to the next higher 100-ft increment (see figure 2-9 for an example MCA computation).

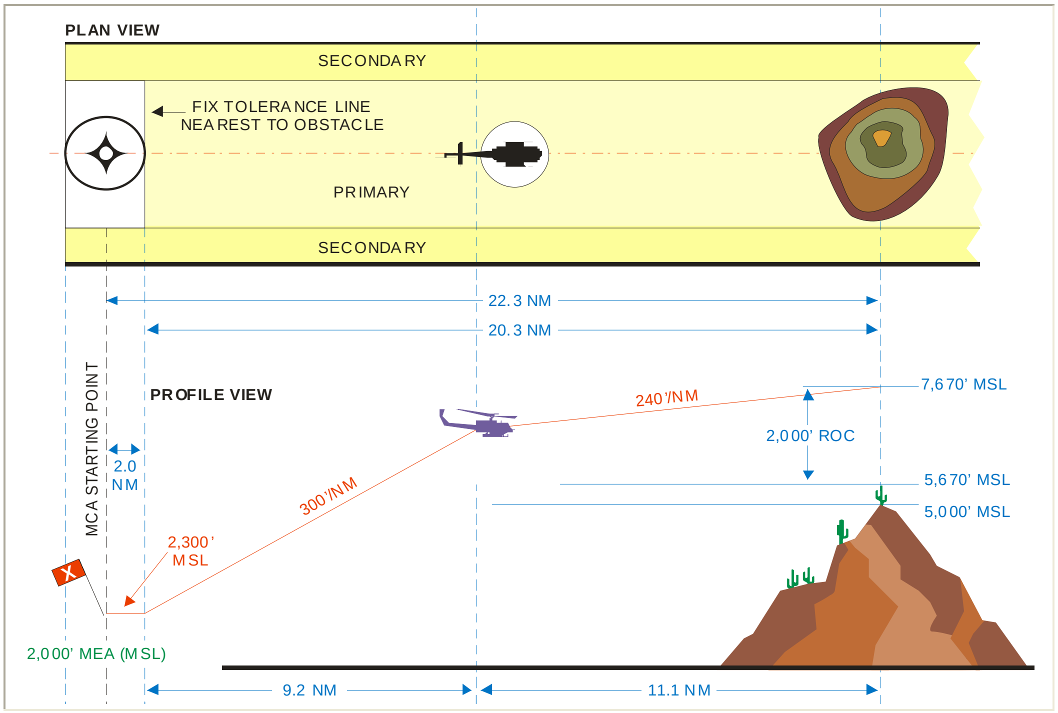
Note: The USA standard climb gradient is 400 ft/NM for all altitudes.

f. Determine MCA. Apply formula 2-11a, or 2-11b to determine MCA.

Formula 2-11a. MCA Sea Level to 5,000 ft MSL.		
$MCA = A\text{-}300 \cdot L$ Where: A = "Climb to" MSL Altitude L = Length of segment (NM)		
A-300*L		
Calculator		
A		Click here to calculate
L		
MCA		

Formula 2-11b. MCA 5,000 - 10,000 ft MSL.		
$MCA = 5000 - 300(L\text{-}\frac{A\text{-}5000}{240})$ Where: A = "Climb to" MSL Altitude L = Length of segment (NM)		
5000-300*(L-(A-5000)/240)		
Calculator		
A		Click here to calculate
L		
MCA		

Figure 2-9. Minimum Crossing Altitude (MCA).



Step 1: Add 2,000 ft mountainous ROC to MSL height of obstacle.

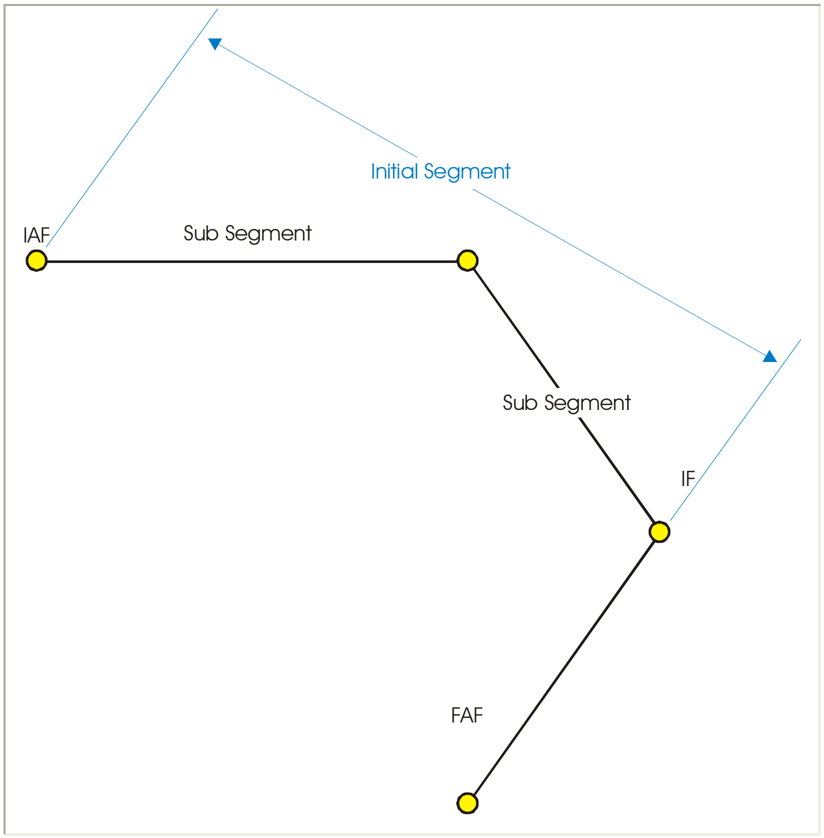
Step 2: Apply formula 2-11a or 2-11b to determine the MCA**.**

Chapter 2. General Criteria

Section 2. Terminal Segments

9. Initial Segment. The initial segment begins at the IAF and ends at the intermediate fix (IF). The initial segment may contain sequences of straight sub segments (see figure 2-10). Chapter 2, paragraphs 9b, 9c, 9d, and 9e apply to all sub segments individually. The total length of all sub segments must not exceed 50 NM. For descent gradient limits, see chapter 2, paragraph 8d.

Figure 2-10. Initial Sub Segments.



a. Course Reversal. The optimum design incorporates either the basic Y or T configuration (see AIM or FHP for further BASIC T/Y information). This design eliminates the need for a specific course reversal pattern. Where the optimum design cannot be used and a course reversal is required, establish a holding pattern at the initial, or intermediate approach fix. See chapter 2, paragraph 9f(2). The maximum course change at the fix (IAF/IF) is to 90 degrees (70 degrees above FL 190).

b. Alignment. Design initial/initial and initial/intermediate TF segment intersections with the smallest amount of course change that is necessary for the procedure. No course change is optimum. Where a course change is necessary, it should normally be limited to 70 degrees or less; 30 degrees or less is preferred. The maximum allowable course change between TF segments is 90 degrees.

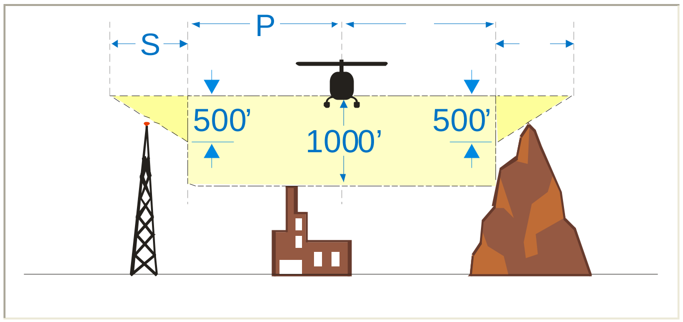
Note: For USA, limit initial segment turn to a MAXIMUM of 60 degrees with a basic "Y" approach configuration for COPTER RNAV (GPS) procedures.

c. Area – <u>Length</u>. The **maximum** segment length (total of sub segments) is 50 NM. Minimum length of sub segments is determined as described in chapter 2, paragraphs 6a(2) and 6b(1).

d. Area – <u>Width</u> (see table 2-2)**.**

e. Obstacle Clearance. The initial OEA begins at the segment beginning fix early ATT and ends at the segment ending fix late ATT. Apply 1,000 ft of ROC over the highest obstacle in the primary OEA. The ROC in the secondary area is 500 ft at the primary boundary tapering uniformly to zero at the outer edge (see figure 2-11).

Figure 2-11. En route/Feeder/Initial Segment ROC.



Note: Allowance for precipitous terrain should be made as specified in Order 8260.3, Volume 1, paragraph 3.2.2b.

Calculate the secondary ROC values using formula 2-12a.

Formula 2-12a. En route/Feeder/Initial Secondary ROC (Standard).

$$ROC_{secondary} = 500 \cdot \left(1 - \frac{d}{D}\right)$$

Where:
D = width (ft) of secondary
d = distance (ft) from edge of primary area measured perpendicular to boundary

500*(1-d/D)

Calculator

d		Click here to calculate
D		
$ROC_{secondary}$		

Calculate the secondary ROC values for designated mountainous areas using formula 2-12b. Consult Order 8260.3 para 1720 b (1) for possible adjustments to formula output.

Formula 2-12b. En Route/Feeder/Initial Secondary ROC (Mountainous).

$$ROC_{secondary} = 500 \cdot \left(1 - \frac{d}{D}\right) + 1000$$

Where:

D = width (ft) of secondary

d = distance (ft) from edge of primary area measured perpendicular to boundary

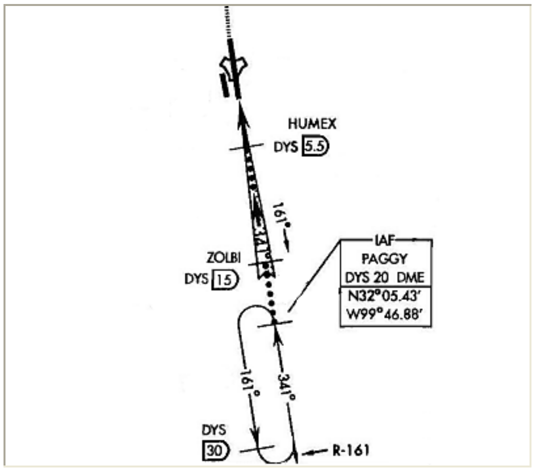
500*(1-d/D)+1000

Calculator		
d		Click here to calculate
D		
$ROC_{secondary}$		

f. Holding Pattern Initial Segment. A holding pattern may be incorporated into the initial segment procedure design where an operational benefit can be derived; e.g., arrival holding at an IAF, course reversal pattern at the IF, etc. See FAA Order 7130.3, Holding Pattern Criteria, for RNAV holding pattern construction guidance.

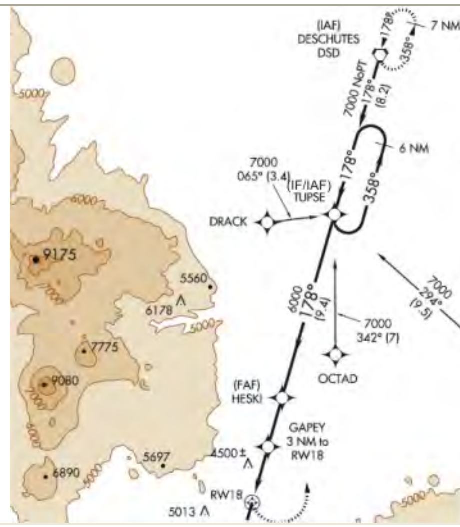
(1) Arrival Holding. Ideally, the holding pattern inbound course should be aligned with the subsequent TF leg segment (tangent to course at the initial fix of the subsequent RF segment). See figure 2-12a. If the pattern is offset from the subsequent TF segment course, the subsequent segment length must accommodate the resulting DTA requirement. Establish the minimum holding altitude at or above the IAF/IF (as appropriate) minimum altitude. MEA minimum altitude may be lower than the minimum holding altitude.

Figure 2-12a. Arrival Holding Example.



(2) Course Reversal. Ideally, establish the minimum holding altitude as the minimum IF fix altitude (see figure 2-12b). In any case, the published holding altitude must result in a suitable descent gradient in the intermediate segment: optimum descent gradient in the initial and intermediate segment is 400 ft/NM (6.58%, 3.77°); maximum is 600 ft/NM (9.87%, 5.64°). If the pattern is offset from the subsequent TF segment course, the subsequent segment length must accommodate the resulting DTA requirement. Maximum offset is 90 degrees.

Figure 2-12b. Course Reversal Example.



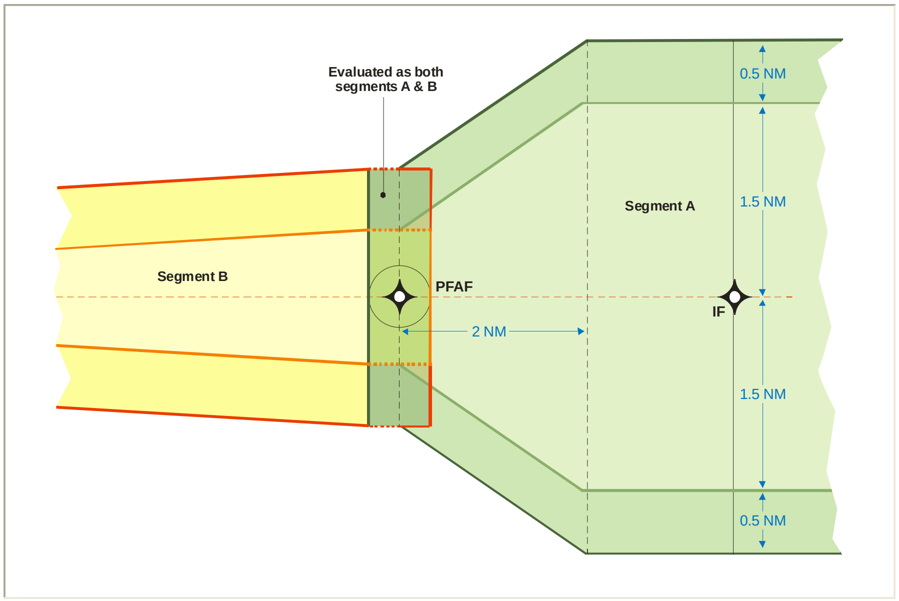
10. Intermediate Segment. The intermediate segment primary and secondary boundary lines connect abeam the plotted position of the PFAF at the appropriate primary and secondary final segment beginning widths.

a. Alignment (Maximum Course Change at the PFAF)**.** LNAV & LP. Align the intermediate course within 30 degrees of the final approach course (30 degrees maximum course change).

b. Length (Fix to Fix)**.** The **minimum** Helicopter category segment length is 2 NM. Where turns over 30 degrees at the IF are required, the minimum is 3 NM. Where turns to and from the intermediate segment are necessary, determine minimum segment length using formula 2-6 or formula 2-7, as appropriate.

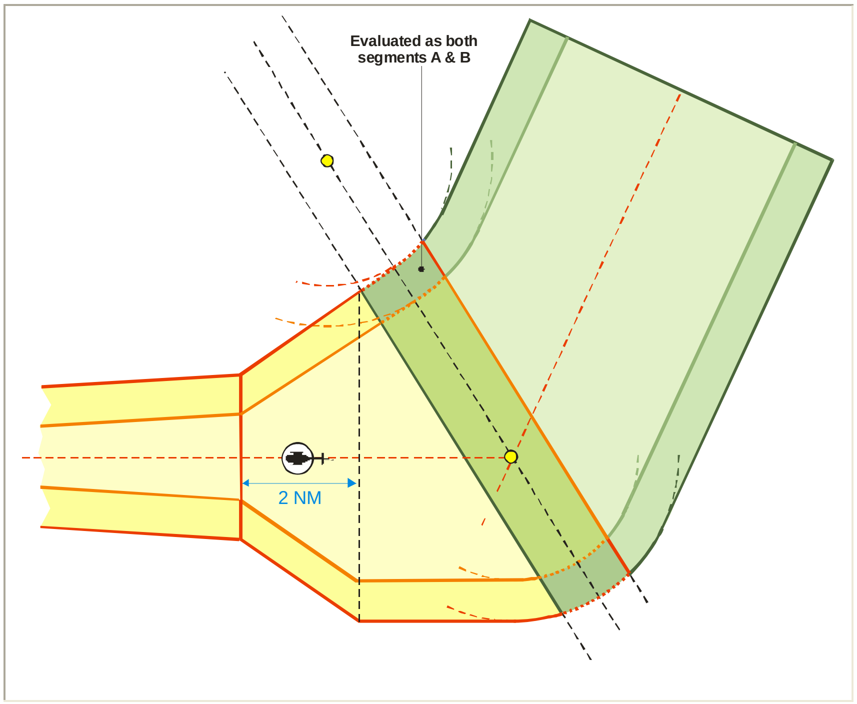
c. Width. The intermediate segment primary area tapers uniformly from ± 1.5 NM at a point 2 NM prior to the PFAF to the outer boundary of the X OCS abeam the PFAF (1 NM past the PFAF for LNAV). The secondary boundary tapers uniformly from 1 NM at a point 2 NM prior to the PFAF to the outer boundary of the Y OCS abeam the PFAF (1 NM past the PFAF for LNAV). See figure 2-13a.

Figure 2-13a. RNAV Intermediate Segment (LNAV Final).



If a turn is designed at the IF, it is possible for the inside turn construction to generate boundaries outside the normal segment width at the taper beginning point 2 miles prior to the PFAF. Where these cases occur, the inside (turn side) boundaries are a simple straight line connections as illustrated in figure 2-13b.

Figure 2-13b. RNAV Turn at IF (LNAV Final).



Maximum turn at the PFAF is 30 degrees. When a PFAF turn is constructed, **minimum** FAS length is 3 NM for turns greater than 15 degrees. Where the RNAV or LP intermediate course is not an extension of the FAC, use the following construction (see figure 2-13c).

(1) LNAV Offset Construction. Where LNAV intermediate course is not an extension of the final course, use the following construction (see figure 2-13c, upper graphic).

Step 1: Construct line A perpendicular to the intermediate course 2 NM prior the PFAF.

Step 2: Construct line B perpendicular to the intermediate course extended 1 NM past the PFAF.

Step 3: Construct the inside turn boundaries by connecting the points of intersection of line A with the turn side intermediate segment boundaries with the intersection of line B with the turn side final segment boundaries.

Step 4: Construct arcs centered on the PFAF of 1 NM and 1.5 NM radius on the non-turn side of the fix.

Step 5: Connect lines from the point of intersection of line A and the outside primary and secondary intermediate segment boundaries to tangent points on the arcs constructed in step 4.

Step 6: Connect lines tangent to the arcs created in step 4 that taper inward at 30 degrees relative to the FAC to intersect the primary and secondary final segment boundaries as appropriate.

The final segment evaluation extends to a point ATT prior to the angle bisector. The intermediate segment evaluation extends ATT past the angle bisector. Therefore, the area within ATT of the angle bisector is evaluated for both the final and intermediate segments.

(2) LP Offset Construction. Where LP intermediate course is not an extension of the final course, use the following construction (see figure 2-13c, lower graphic).

Step 1: Construct line A perpendicular to the intermediate course 2 NM prior the PFAF.

Step 2: Construct line B perpendicular to the intermediate course extended 1 NM past the PFAF.

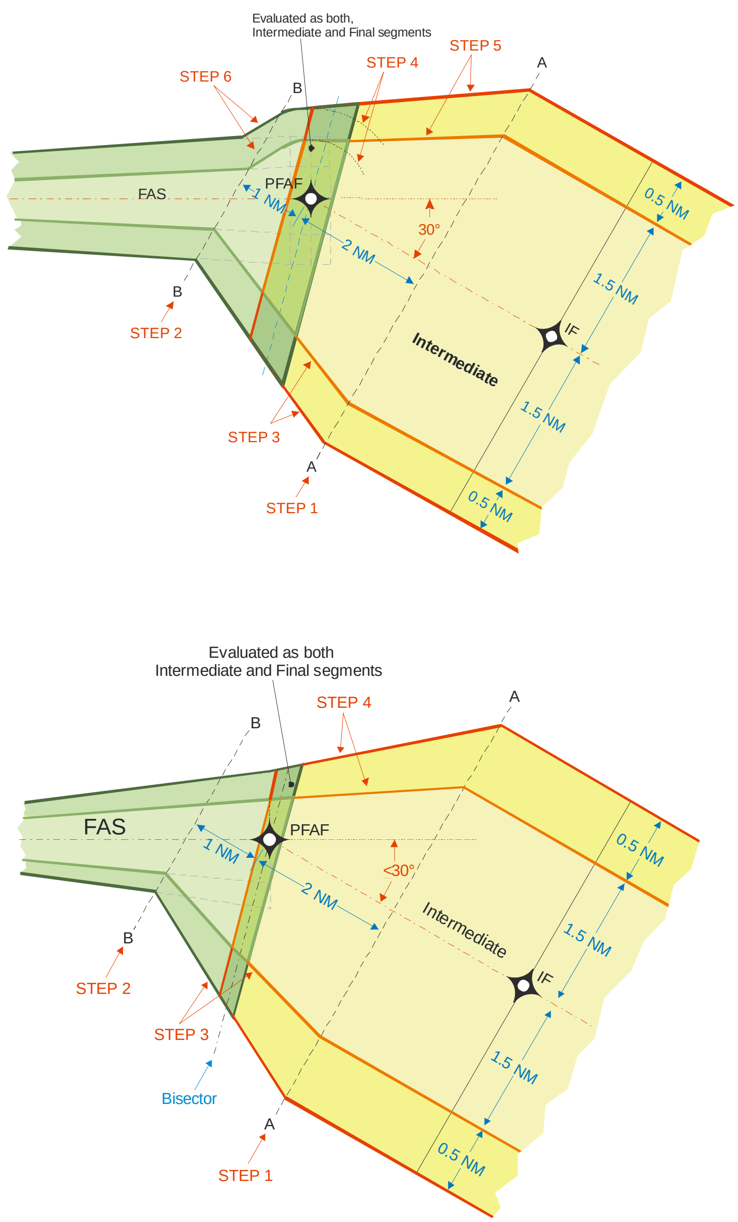
Step 3: Construct the inside turn boundaries by connecting the points of intersection of line A with the turn side intermediate segment boundaries with the intersection of line B with the turn side final segment boundaries.

Step 4: Connect lines from the point of intersection of line **A** and the outside primary and secondary intermediate segment boundaries to the final segment primary and secondary final segment lines at a point perpendicular to the final course at the PFAF.

Note: DA must not occur at a greater distance from HRP than the turn-side point of intersection of the expanded outer boundary line with the final segment secondary boundary (intersection of line "B" with secondary boundary in figure 2-13c lower graphic). If a higher DA is required, then the degree of offset must be less.

The final segment evaluation extends to a point ATT prior to the angle bisector. The intermediate segment evaluation extends ATT past the angle bisector. Therefore, the area within ATT of the angle bisector is evaluated for both the final and intermediate segments.

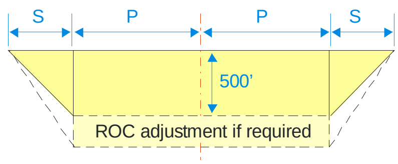
Figure 2-13c. Offset LNAV/LP Turn at PFAF Construction.



(3) RF intermediate segments. **Reserved.**

d. Obstacle Clearance. The intermediate OEA begins at the segment beginning fix early ATT and ends at the segment ending fix late ATT. Apply 500 ft of ROC over the highest obstacle in the primary OEA. The ROC in the secondary area is 500 ft at the primary boundary tapering uniformly to zero at the outer edge (see figure 2-14).

Figure 2-14. Intermediate Segment ROC.



Calculate intermediate secondary ROC values using formula 2-13.

Formula 2-13. Intermediate Secondary ROC.

$$ROC_{secondary} = (500 + adj) \cdot \left(1 - \frac{d_{primary}}{W_S}\right)$$

Where:

$d_{primary}$ = perpendicular distance (ft) from edge of primary area

W_S = Width (ft) of the secondary area

adj = TERPS para 3.2.2 adjustments

$(500+adj)*(1-d_{primary}/W_S)$

Calculator

$d_{primary}$		Click here to calculate
W_S		
Adj		
$ROC_{secondary}$		

e. Minimum IF to FHP Distance (applicable for LP procedures with no turn at PFAF)**.** Locate the IF at least d_{IF} (NM) from the FHP (see formula 2-14).

Formula 2-14. Minimum IF Distance.		

$$d_{IF} = 0.3 \cdot \frac{d}{a} - d \cdot \frac{0.3048}{1852}$$

Where:

d = distance (ft) from FPAP to FHP
a = width (ft) of azimuth signal at FHP

Note: See chapter 4, table 4-1, column 3

0.3*d/a-d*0.3048/1852

Calculator

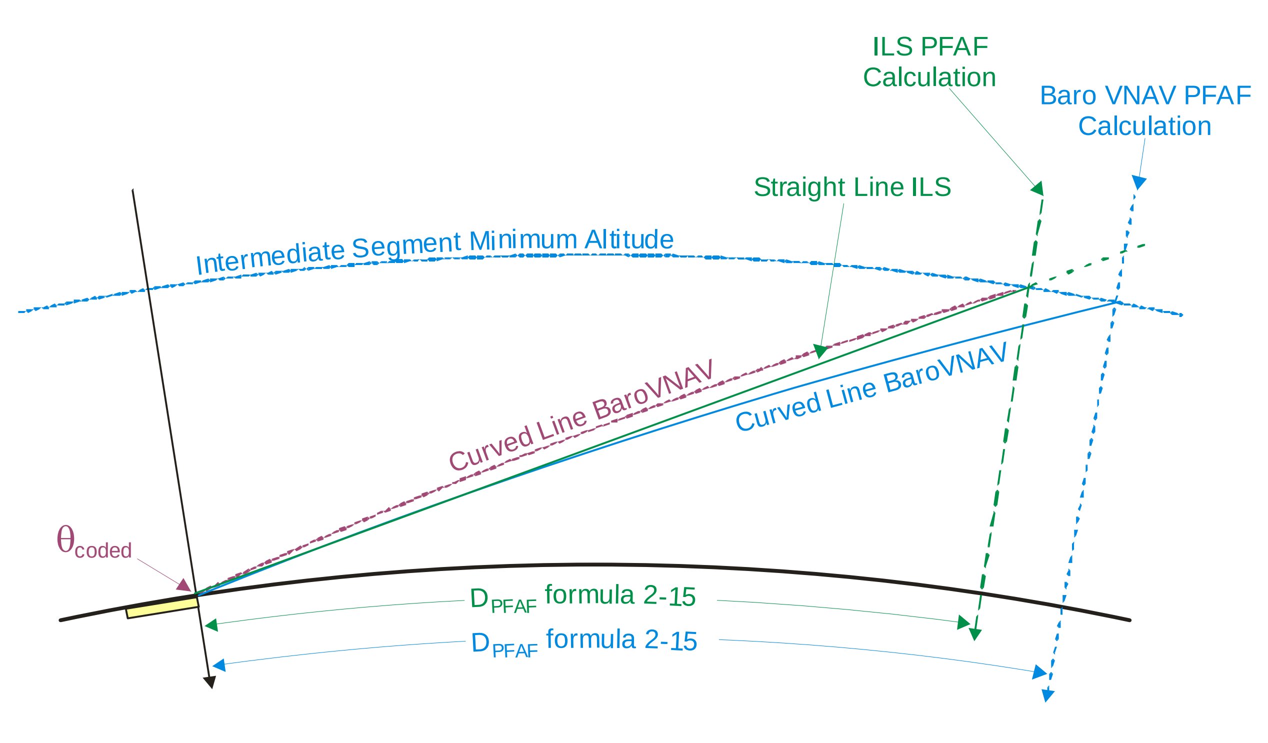
a		Click here to calculate
d		
d_{IF}		

Chapter 2. General Criteria

Section 3. Basic Vertically Guided Final Segment General Criteria

11. Determining Precise Final Approach Fix/Final Approach Fix (PFAF/FAF) Coordinates (see figure 2-15 fixed-wing example)**.**

Figure 2-15. Determining PFAF Distance to LTP (Example).



Geodetically calculate the latitude and longitude of the PFAF using the true bearing from the Heliport Reference Point (HRP) to the PFAF and the horizontal distance (D_{PFAF}) from the HRP to the point the glidepath intercepts the intermediate segment altitude. The LNAV (BaroVNAV) glidepath is a curved line (logarithmic spiral) in space. Calculation the PFAF distance from the HRP using formula 2-15 (calculates the LNAV PFAF distance from HRP; i.e., the point the curved line BaroVNAV based vertical path intersects the minimum intermediate segment altitude (see Order 8260.54A, chapter 2 for additional information).

Formula 2-15. LNAV PFAF.	

$$D_{PFAF} = \frac{\ln\left(\frac{r + alt}{r + HRP_{elev} + HCH}\right) \cdot r}{\tan\left(\theta \cdot \frac{\pi}{180}\right)}$$

where alt = minimum intermediate segment altitude
HRP_{elev} = HRP MSL elevation
HCH = Heliport Crossing Height value
r = 20890537
θ = glidepath angle

(ln((r+alt)/(r+HRP_{elev}+HCH))*r)/tan(θ*π/180)

Calculator

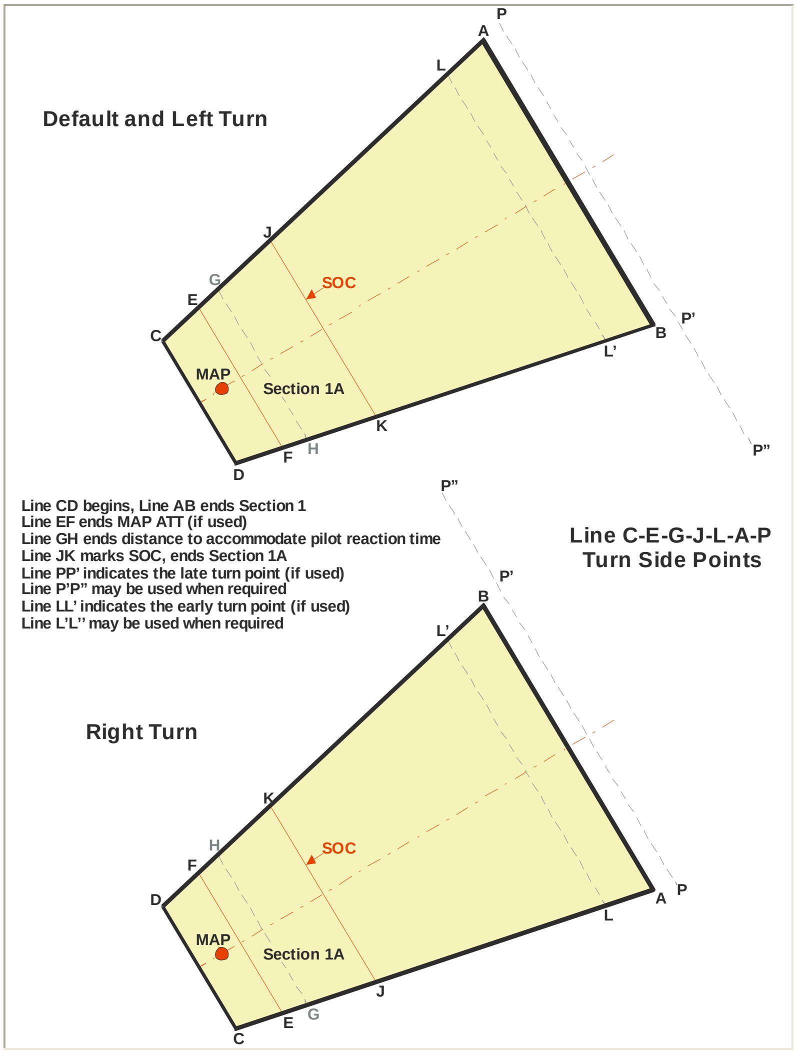
HRP_{elev}		Click here to calculate
HCH		
θ	°	
alt		
D_{PFAF}		

12-15. Reserved.

16. Common Fixes. Design all procedures published on the same chart to use the same sequence of charted fixes.

17. Missed Approach Segment (MAS) Conventions. Figure 2-16 defines the MAP point OEA construction line terminology and convention for section 1.

Figure 2-15. MAS Point/Line Identification.



The missed approach obstacle clearance standard is based on a minimum helicopter climb gradient of 400 ft/NM, protected by a ROC surface that rises at 304 ft/NM. The MA ROC value is based on a requirement for a 96 ft/NM (400-304 = 96) increase in ROC value from the start-of-climb (SOC) point located at JK. The actual slope of the MA surface is (1 NM in feet)/304≈ 19.987. In manual application of TERPS, the rounded value of 20:1 has traditionally been applied. However, this order is written for automated application; therefore, the full value (to 15 significant digits) is used in calculations. The nominal OCS slope ($MA_{OCSslope}$) associated with any given missed approach climb gradient is calculated using formula 2-16.

Formula 2-16. Helicopter Missed Approach OCS Slope.

$$MA_{OCSslope} = r \bullet \ln\left(\frac{\frac{1852}{0.3048 \cdot (CG - 96)} + r}{r}\right)$$

Where:

CG = Climb Gradient (nominally 400 ft/NM)

r*ln((1852/(.3048*(CG-96))+r)/r)

Calculator

CG		Click here to calculate
$MA_{OCSslope}$		

a. Charted Missed Approach Altitude. Apply Order 8260.3, Volume 1, paragraphs 277d and 277f to establish the preliminary and charted missed approach altitudes.

b. Climb-In-Holding. Apply Order 8260.3, Volume 1, paragraph 277e for climb-in-holding guidance.

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Chapter 3. Terminal Operations

1. Approach Configuration. The BASIC “Y” or “T” approach configuration should be the basis of procedure design. Segment length is affected by altitude to be lost, fix tolerances, and turn magnitude at the fixes. The **optimum** design incorporates a basic **Y** or **T** configuration. This design eliminates the need for a specific course reversal pattern. Where the **optimum** design cannot be used and a course reversal is required, establish a holding pattern at the initial or intermediate approach fix. Public procedures should not deviate from these shape and dimension configurations unless there is an operational advantage. Construct IAFs within 25 NM of the airport reference point/heliport reference point (ARP/HRP). See chapter 2, paragraph 9 for construction methods.

Note 1: Allowance for precipitous terrain should be made as specified in Order 8260.3, Volume 1, paragraph 3.2.2b.

Note 2: For USA, limit initial segment turn to a MAXIMUM of 60 degrees with a basic “Y” approach configuration for COPTER RNAV (GPS) procedures.

Table 3-1. Helicopter GPS MINIMUM Initial/Intermediate/Final Segment Lengths.

Course Intercept Angle (Degrees)	Minimum Leg Length (NM)
00 – 30	2.0
> 30 - 90 *	3.0

* Final segment 30-degree MAXIMUM intercept angle for Global Positioning System (GPS) and Wide Area Augmentation System (WAAS) public procedures. Final segment 60-degree MAXIMUM intercept angle for GPS and WAAS special procedures. A turn exceeding 30 degrees at the precise final approach fix (PFAF) requires documentation of equipment capability.

a. Initial Approach Segment. The initial approach segment begins at the IAF and ends at the IF. The initial segment/subsegment obstacle evaluation area (OEA) begins at the early ATT of the segment beginning fix and ends at the late ATT of the segment/subsegment ending fix. If a special procedure requires a course change at the IAF that exceeds 90 degrees, a waiver is required and is noted on FAA Form 8260-9 (no course change exceeding 120 degrees is allowed). The IF may be identified as an along-track distance (ATD) from the PFAF. Course change at the IF must not exceed 90 degrees for public and special procedures. Construct the inbound leg of course reversal holding patterns within 30 degrees of the intermediate course (IF/IAF). Apply chapter 2, paragraph 9 for course reversal using holding pattern criteria. Do not establish a holding pattern in lieu of procedure turn at the PFAF. See chapter 2 for construction methods.

(1) Length. The initial segment begins at IAF and ends at the IF. The length should not exceed 10 NM unless operational requirements mandate a longer segment. Determine the **minimum** length using the greater distance from formulas 2-7, 2-8, and table 3-1.

(2) Width.

(a) Primary Area. 1.5 NM each side of the course centerline.

(b) Secondary Area. 0.5 NM on each side of the primary area.

(3) Obstacle Clearance. Provide a **minimum** of 1,000 ft of required obstacle clearance (ROC) in the primary area. In the secondary area, provide 500 ft of ROC at the inner edge, tapering uniformly to zero at the outer edge (see chapter 2, figure 2-12). Calculate the secondary ROC using chapter 2, formula 2-12a or formula 2-12b. Establish initial segment altitudes in 100-ft increments that meet or exceed minimum ROC.

(4) Descent Gradient for Initial Segments (see chapter 2, paragraph 7).

b. Intermediate Segment. The intermediate segment begins at the IF and ends at the PFAF. The intermediate segment OEA begins at the early ATT of the segment beginning fix and ends at the late ATT of the segment ending fix. The intermediate segment is used to prepare the helicopter speed and configuration for final approach segment entry; therefore, the gradient should be as flat as possible. At a point beginning 2.0 NM from the PFAF, construct a taper to join the final approach segment (FAS).

(1) Alignment. The **maximum** course change at the PFAF is 30 degrees. Course change more than 30 degrees requires Flight Standards approval.

(2) Area.

(a) Length. The intermediate segment begins at the IF and ends at the PFAF. The length should not exceed 5.0 NM (**optimum** length is 3.0 NM). Determine the **minimum** length using the greater distance from formulas 2-7, 2-8, and table 3-1.

(b) Width.

1 Primary Area. 1.5 NM each side of the segment centerline, beginning at the earliest IF position. The segment taper begins 2.0 NM prior to the plotted position of the PFAF to reach a ± 0.55 NM width at the PFAF plotted position (see chapter 2, figures 2-13a, 2-13b, and 2-13c).

2 Secondary Area. 0.50 NM on each side of the primary area.

Note: USAF/USA/USCG/USN operating at 90 KIAS: Change 0.55 NM to 0.70 NM.

(3) Obstacle Clearance. Provide a MINIMUM of 500 ft of ROC in the primary area. In the secondary area, provide 500 ft of ROC at the inner edge tapering to zero feet at the outer edge. Establish altitudes for each intermediate segment in 100-ft increments, and round to the

next higher 100-ft increment. Calculate the secondary ROC using chapter 2, formula 2-13 (see chapter 2, figure 2-14).

(4) Descent Gradient for Intermediate Segments (see chapter 2, paragraph 7).

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Chapter 4. IFR Final and Visual Segments

1. General. The approach procedure type is determined by the visual segment. The instrument flight rule (IFR) final approach segment (FAS) applies to all five types of procedures. Use the criteria in chapter 3 for the construction of the initial and intermediate segments up to the precise final approach fix (PFAF), and chapter 5 criteria for the missed approach segment construction. Apply chapter 4, paragraph 3 criteria to LNAV IFR final segments, and chapter 4, paragraph 9 to WAAS LP IFR final segments.

Note: Chapter 4 graphics are not drawn to scale

a. Final Segment Stepdown Fix (SDF). An SDF may be applied where the MDA can be lowered 60 ft, or a visibility reduction can be achieved. Order 8260.3, Volume 1, paragraph 289 applies, with the following exceptions:

(1) Establish step-down fix locations in 0.10 NM increments.

(2) The minimum distance between stepdown fixes is 1 NM.

(3) Establish stepdown fix altitudes using 20-ft increments, rounded to the next **higher** 20-ft increment. For example, 2104 becomes 2120.

(4) Where a Remote Altimeter Setting Source (RASS) adjustment is in use, the published stepdown fix altitude must be established no lower than the altitude required for the greatest amount of adjustment (i.e., the published minimum altitude must incorporate the greatest amount of RASS adjustment required).

(5) Descent gradient: Chapter 4, paragraphs 3a(3), 3a(4), and 3a(5) apply.

(6) Obstacles eliminated from consideration (3.5:1 area) under this paragraph must be noted in the procedure documentation (see Order 8260.19).

(7) Use formula 4-4 in chapter 4, paragraph 3a(6) concerning Order 8260.3, Volume 1, paragraph 289 to determine the OIS elevation at an obstacle and minimum fix altitude based on an obstacle height.

(8) To mitigate surface penetrations:

- Remove obstruction, or
- Reduce obstruction height, or
- Adjust the MDA, or
- Combination of options.

2. Missed Approach. Construct the missed approach for all procedures using chapter 5 criteria.

3. The five procedure types are:

- IFR to an IFR Heliport
- IFR to a VFR Heliport (IVH) (Proceed Visually)
- IFR to a VFR Runway (IVR) (Proceed Visually)
- Point-in-Space (PinS) Approach (Proceed VFR)
- IFR to an IFR Runway

a. LNAV IFR Final Approach Segment (FAS). The IFR FAS begins at the PFAF and ends at the missed approach point (MAP) (see figure 4-1). This FAS construction is unique to helicopters. It applies trapezoidal rather than the linear construction used for fixed-wing applications. Locate LNAV PFAF using chapter 2, formula 2-15. MAP location should provide the best compromise of lowest visibility and visual segment descent angle (VSDA). The **optimum** distance for the "Proceed Visually" MAP is 0.65 nautical mile (NM) [3/4 statute mile (SM) visibility] from the heliport. For public procedures, the preferred approach paths should be aligned with the prevailing wind direction to avoid downwind and minimize crosswind operations. Other approach/departure paths should be based on the assessment of the prevailing winds or when this information is not available, the separation between such flight paths and the preferred flight path should be at least 135 degrees.

(1) Alignment. The IFR final segment connects the PFAF to the MAP. The course change at the PFAF from the intermediate course to the final approach course (FAC) must not exceed 30 degrees. The MAP is located on the FAC between the PFAF and a point no closer to the helipoint than 0.3 NM from the visual segment reference line (VSRL). For a straight-in approach, the course change at the MAP must not exceed 30 degrees to an IFR heliport helipoint **or** 30 degrees from a runway centerline (RCL) extended to an IFR runway threshold (RWT). Optimum alignment is coincident with the RCL. When the alignment exceeds 5 degrees the optimum alignment point is 1,500 ft from the RWT on RCL. Where circling approaches are required, apply Order 8260.3 Category A criteria.

(2) Area. The obstacle evaluation area (OEA) begins at the earliest PFAF along-track tolerance (ATT) and ends at the latest MAP ATT (see figure 4-1).

(a) Length. The IFR final approach segment begins at the PFAF and ends at the MAP. The length should not exceed 10 NM (**optimum** length is 3 NM). Determine the **minimum** length using the greater of descent distance, formula 2-7 or 2-8, and table 3-1.

(b) Width.

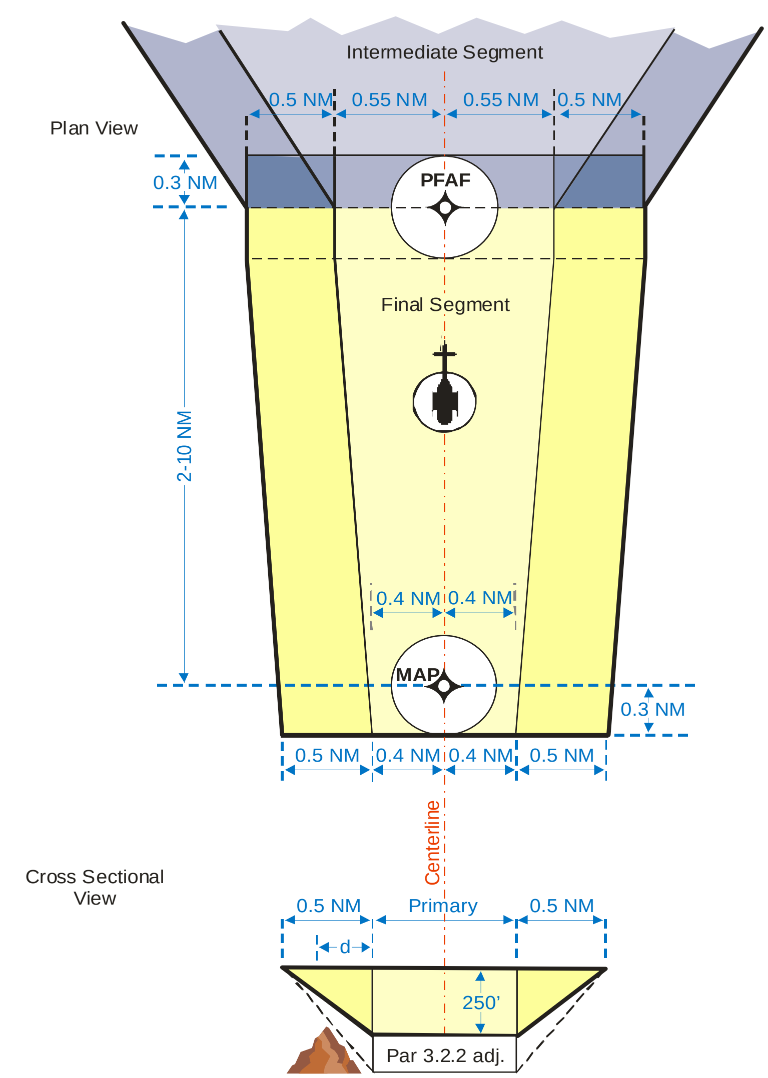
<u>1</u> Primary Area. The primary area boundary begins 0.55 NM***** each side of the final segment centerline at the earliest PFAF ATT. The width remains constant until the latest PFAF ATT. It then tapers to 0.40 NM***** at the latest MAP ATT.

> **Note:** USAF/USA/USCG/USN operating at 90 KIAS: Change 0.55 NM to 0.70 NM and 0.40 NM to 0.50 NM (primary area).

2 Secondary Area. The secondary area boundary is constant, 0.50 NM each side of the primary area. Calculate the primary half-width at any distance from latest MAP ATT using formula 4-1a.

(c) Required Obstacle Clearance. Primary area required obstacle clearance (ROC) is 250 ft. Secondary ROC is 250 ft at the edge of the primary area, tapering uniformly to zero at the outer edge. Calculate secondary ROC using formula 4-1b.

Figure 4-1. LNAV Final Segment Construction.



Formula 4-1a. Final Area Half-Width.(W_P)		
$$W_P = P_{W2} + \left(\frac{P_{W1} - P_{W2}}{D_1}\right) \cdot D_2$$ Where P_{W1} = Primary Width, PFAF, (0.55 or 0.7) NM P_{W2} = Primary Width, latest MAP ATT, (0.4 or 0.5) NM D_1 = PFAF to MAP distance (NM) D_2 = Latest MAP ATT to desired point (NM) W_T = Final Total Width (ft) (WP+0.5NM)		
P_{W2}+((P_{W1}- P_{W2})/D_1)*D_2		
Calculator		
P_{W1}		Click here to calculate
P_{W2}		
D_1		
D2		
W_P (NM)		
W_P (ft)		
W_T(ft)		

Formula 4-1b. Secondary Area ROC ($ROC_{secondary}$).		
$$ROC_{secondary} = (250 + adj) \cdot \left(1 - \frac{d_{primary}}{W_S}\right)$$ Where adj = TERPS para 3.2.2 adjustments (ft) $d_{primary}$ = distance (perpendicular to C/L from primary area (ft)) W_S = Secondary area width (ft)		
(250+adj)*(1-$d_{primary}$/W_S)		
Calculator		
adj		Click here to calculate
$d_{primary}$		
W_S		
$ROC_{secondary}$		

(3) Descent Gradient/Angle [IVH, PinS , and IVR] (R). The descent gradient/angle is measured from the plotted positions of the PFAF at PFAF altitude to the MAP at MDA. Calculate the final segment descent angle using formula 4-2. (Where required, calculate descent gradient using chapter 2, formula 2-10).

Formula 4-2. Final Approach Angle to MAP (DescentAngle).		
$$\text{DescentAngle} = \operatorname{atan}\left(\frac{r}{c}\cdot\ln\left(\frac{r+a}{r+b}\right)\right)\cdot\frac{180}{\pi}$$ Where: c = PFAF to MAP distance (ft) a = PFAF altitude MSL b = MDA at MAP MSL		
atan(r/c*ln((r+a)/(r+b))*180/π		
Calculator		
c		Click here to calculate
a		
b		
DescentAngle		

Note 1: USA **maximum** descent gradient/angle is 478 ft/NM (4.5 degrees) without a waiver. Descent gradient/angle waivers may be granted up to 800 ft/NM (7.5 degrees).

Note 2: The visual segment descent gradient is considered separately in approaches to VFR heliports or VFR runways.

(4) Descent Gradient/Angle to an IFR Runway or an IFR Heliport. Apply the same descent gradient/angle in chapter 4, paragraph 3a(3) for an IFR approach to an IFR runway, but the distance/elevation calculations begin at the PFAF and end at RWT/TCH elevation (see figure 4-2b). For an IFR approach to an IFR Heliport, the distance/elevation calculations begin at the PFAF and end at HCH (see figure 4-2c). Apply formula 4-3 for descent angle, and chapter 2, formula 2-10 for descent gradient:

Formula 4-3. Descent Angle to Runway or HCH (DescentAngle).

$$DescentAngle = \operatorname{atan}\left(\frac{r}{c}\cdot\ln\left(\frac{r+a}{r+b}\right)\right)\cdot\frac{180}{\pi}$$

Where:

c = PFAF to RWT/helipoint distance (ft)
a = PFAF Altitude MSL
b = TCH/HCH elevation at RWT or HCH

atan(r/c*ln((r+a)/(r+b))*180/π

Calculator

c		Click here to calculate
a		
b		
DescentAngle	°	

Figure 4-2a. Descent Angle, PFAF to MAP for IVH/PinS/IVR Procedures.

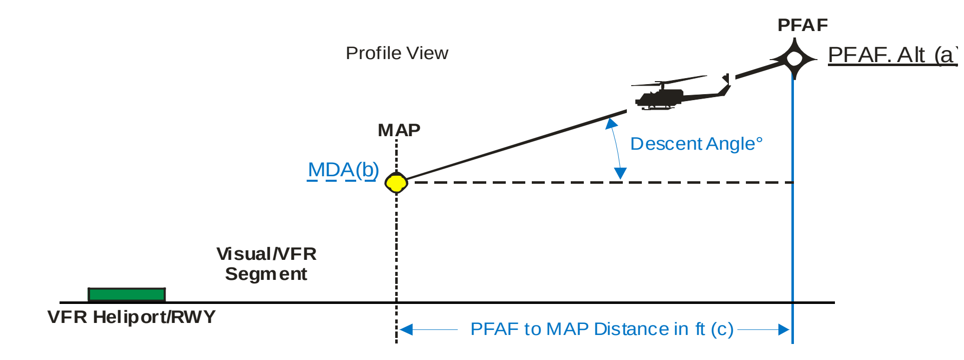


Figure 4-2b. Descent Angle, PFAF to TCH for IFR Approach to IFR Runway.

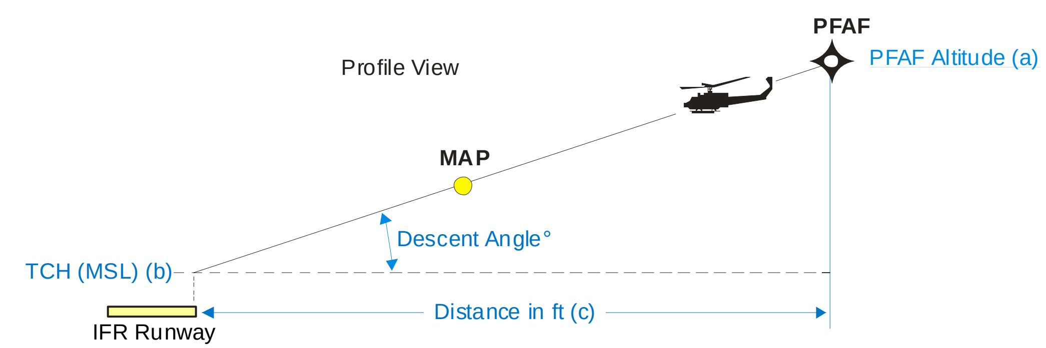
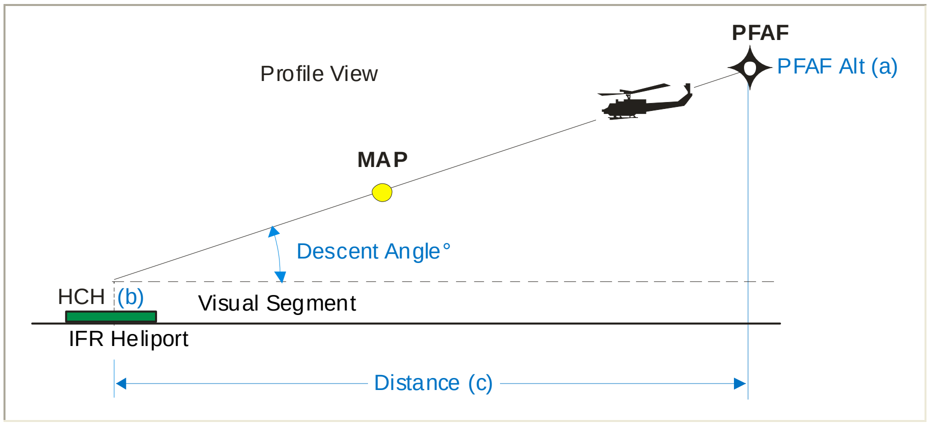


Figure 4-2c. Descent Angle,
PFAF to HCH for IFR Approach to IFR Heliport.



(5) Stepdown Descent Gradient/Angle. When a stepdown fix is used, measure the descent gradient/angle from the PFAF at the PFAF altitude to the stepdown fix at the minimum fix altitude, then to the MAP at the MDA. For a stabilized approach, provide a constant gradient/angle from the PFAF to the MAP, (may require raising the PFAF altitude). A stepdown fix must be located no closer than 0.6 NM to the PFAF or MAP.

(6) Existing Obstacles Close to the PFAF or Stepdown Fix. If the segment descent gradient/angle is less than 800 ft/NM (7.5 degrees), Order 8260.3B, Volume 1, paragraph 289 may be applied substituting an OIS slope of 3.5:1 vice 7:1. Calculate the OIS Elevation and Minimum fix altitude using formula 4-4.

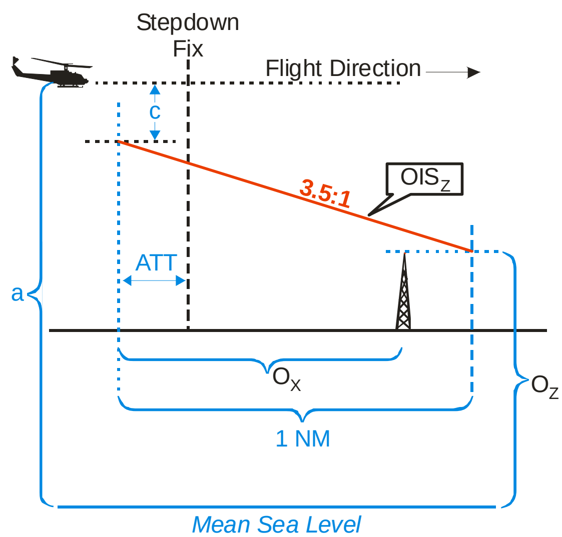
Formula 4-4. OIS Elevation & Minimum Fix Altitude (OIS_z & MFa).

$$OIS_z = (r + a - c) \cdot e^{\frac{-O_x}{3.5 \cdot r}} - r$$

$$MFa = (r + O_z + c) \cdot e^{\frac{O_x}{3.5 \cdot r}} - r$$

Where:

a = MSL fix altitude (ft)
c = ROC plus adjustments (Order 8260.3, Volume 1, para 3.2.2)
O_X = Obstacle along-track distance (ft) from ATT prior to fix (1 NM max)
O_Z = MSL obstacle elevation (ft)
MFa = Minimum Fix Altitude (rounded to next higher 100-ft increments)



OISZ=(r+a-c)*e^(-O_X/(3.5*r))-r
MFa=(r+O_Z+c)*e^(O_X/(3.5*r))-r

Calculator

a		Click here to calculate
c		
O_X		
O_Z		
OIS_Z		
MFa		

4. IFR Heliport Visual Segment. The IFR Heliport visual segment connects the MAP to the helipoint. The visual segment OCS starts at the VSRL and extends to the later of a point 250 ft below the MDA or the latest MAP ATT (see figures 4-3 and 4-4).

a. Alignment. The IFR Heliport visual segment connects the MAP to the helipoint. The course change at the MAP from the FAC must not exceed 30 degrees.

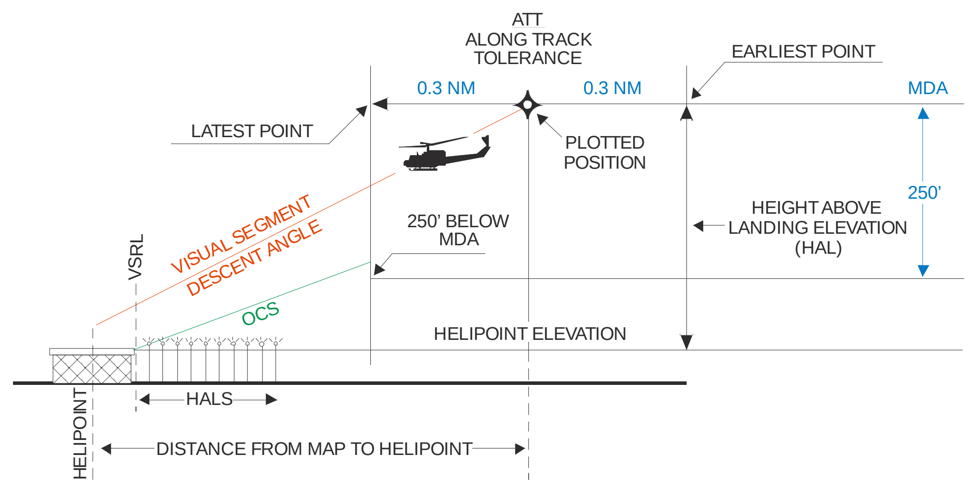
b. Area. The obstacle evaluation area (OEA) begins at the Visual Segment Reference Line (VSRL) and extends toward the MAP as defined below:

(1) Length. The IFR Heliport Visual segment begins at the MAP and ends at the Heliport (see profile figures 4-3 and 4-4).

(2) Width. The visual segment splay begins at the Visual Segment Reference Line (VSRL). It splays from the VSRL endpoints relative to the FAC to the latest FAS primary area width at the latest MAP ATT (see plan view figure 4-6 (right)). Where the OCS surface extends to a point 250 ft below the MDA, the boundary follows the primary area to its end point (see plan view figures 4-4 and 4-6 (left)).

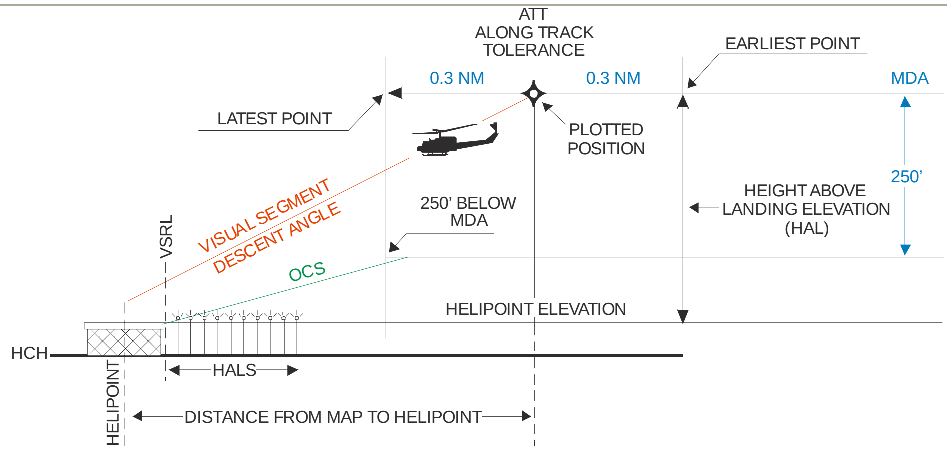
c. Obstacle Clearance Surface. The OCS begins at the VSRL and extends 1.0 degree below the VSDA (see figures 4-3 and 4-4).

Figure 4-3. IFR Heliport Visual Segment OCS Terminating at Latest MAP Position.



OCS REACHES MDA MINUS 250' FIRST THEN ENDS AT THE LATEST MAP POSITION
See Figure 4-6 (Right) .

Figure 4-4. IFR Heliport Visual Segment OCS Terminating at an Altitude 250 ft Below MDA.



OCS REACHES THE LATEST MAP POSITION FIRST THEN ENDS AT MDA MINUS 250' (VSL 250)

See Figure 4-6 (Left)

Figure 4-5. IFR Heliport Visual Segment Area.

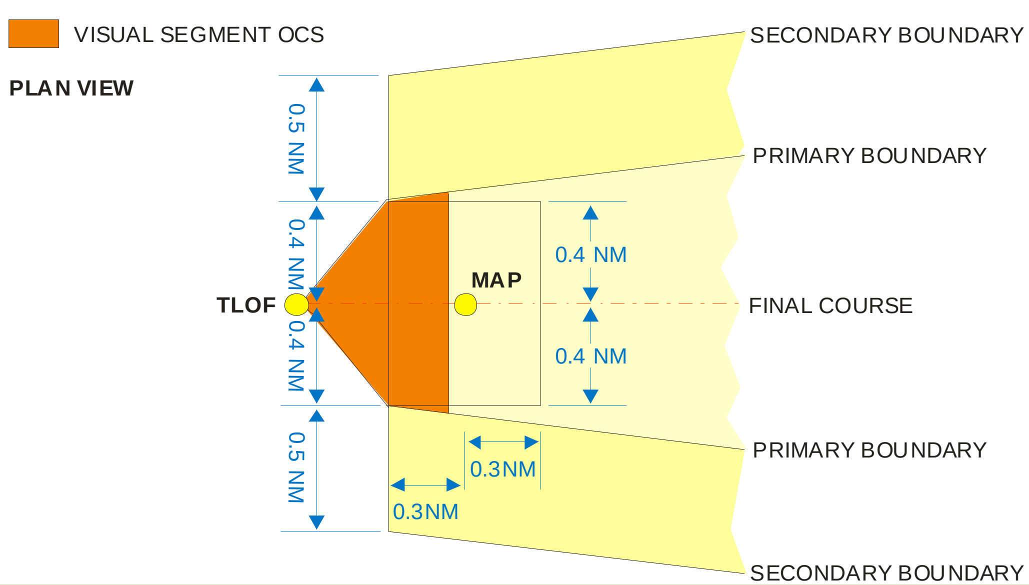
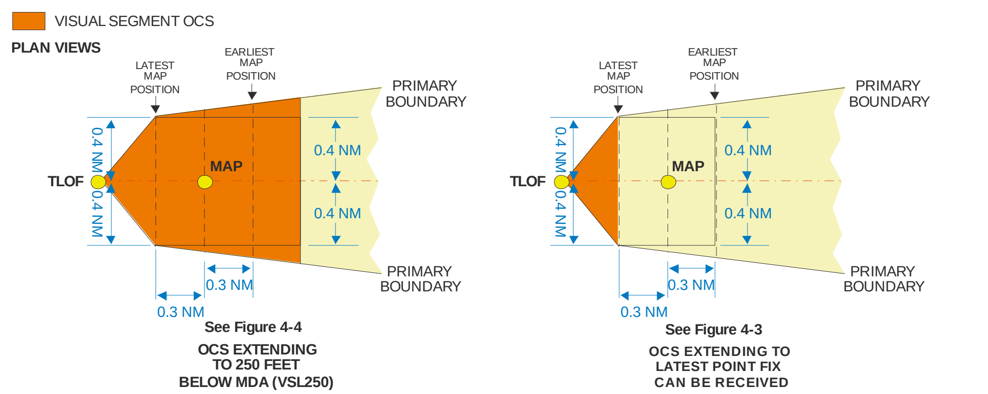


Figure 4-6. IFR Heliport Visual Segment Area Splays.



d. IFR Heliport with Visual Segment Descent Point (VSDP). A VSDP may be established for straight-in helicopter GPS procedures. Apply the VDP concepts in Order 8260.3, Volume 1, paragraph 253, except use helipoint elevation vice RWT elevation and HCH vice TCH. The recommended descent angle from the VSDP is 6.0 degrees. The **maximum** angle is 7.5 degrees. Locate the VSDP on the FAC at the point where the visual glide slope indicator (VGSI) on-glide slope beam intersects the MDA. Publish the VSDP as an ATD from the MAP. Do not publish a VSDP where the VSDP falls between the MAP and the helipoint. Where a VGSI is not established, calculate the VSDP to helipoint distance along the FAC using formula 4-5:

Note: Where **no** VSDP has been established, refer to chapter 4, paragraph 4e, then proceed from chapter 4, paragraph 4d(1).

Formula 4-5. VSDP to Heliport Distance ($VSDP_{dist}$).

$$VSDP_{dist} = \frac{\left(r \cdot \ln\left(\frac{r + MDA}{r + HE + HCH}\right)\right)}{\tan\left(VSDA \cdot \frac{\pi}{180}\right)}$$

Where:

MDA = Final Minimum Descent Altitude (MDA)
HE = Heliport Elevation
HCH = Heliport Crossing Height
VSDA = descent angle (see formula 4-8)

(r*ln((r+MDA)/(r+HE+HCH))/tan(VSDA*π/180)))

Calculator		
MDA		Click here to calculate
HE		
HCH		
VSDA	°	
$VSDP_{dist}$		

(1) Alignment. The VSDP-based visual segment connects the FAC/VSDP to the helipoint. No course change is allowed at the VSDP.

(2) Area. The obstacle evaluation area (OEA) begins at the VSDP and ends at the helipoint/VSRL (see figure 4-7).

(a) Length. The VSDP-based visual segment begins at the VSDP and ends at the helipoint/VSRL. Determine the VSDP-based visual segment length, VSDP-based descent angle, HAL, and VSRL to a point 250 ft below MDA (VSL_{250}) using the following steps (see figure 4-7).

(b) Width. The VSDP-based visual segment begins at the VSRL. It splays from the VSRL ends at a 10-degree angle relative the FAC until reaching the VSDP.

(3) Obstacle Clearance. No obstacle may penetrate the VSDP-based visual segment OCS (see figure 4-7). Calculate the OCS MSL elevation at any point between the VSRL and the VSDP using formula 4-6. Evaluate obstacles based on the shortest obstacle to surface origin distance (VSRL), measured parallel to the visual segment centerline. Calculate the OCS MSL elevation at a specified obstacle location using formula 4-6.

Formula 4-6. OCS Elevation (OCS_{elev}).

$$OCS_{elev} = (r+HE)\cdot e^{\frac{D\cdot \tan\left(\beta\cdot\frac{\pi}{180}\right)}{r}} - r$$

Where:

HE = Helipoint elevation MSL

D = Distance obstacle to VSRL(ft)

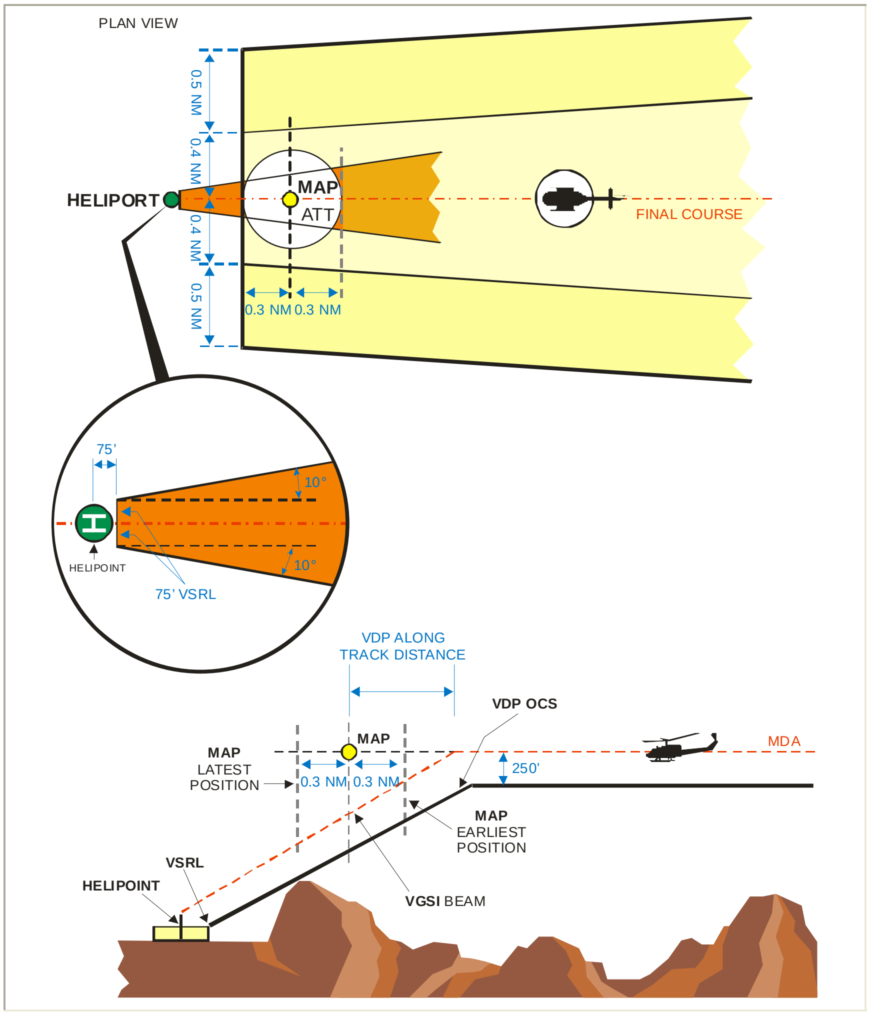
β = OCS Angle

(r+HE)*e^(D*Tan(β*π/180)/r)-r

Calculator

HE		Click here to calculate
D		
β	°	
OCS_{elev}		

Figure 4-7. IFR Heliport VSDP OCS.



(4) IFR Heliport HAL, VSDA-based Visual Segment Length (VSL250), and Visual Segment Descent Angle (VSDA) Computations. Calculate HAL, VSRL to a point 250 ft below MDA (VSL_{250}), and VSDA using the following steps (see figure 4-7):

(a) Calculate HAL using formula 4-7:

Formula 4-7. OCS Elevation (HAL).		
HAL= MDA-Helipoint Elevation (HE)		
MDA-HE		
Calculator		
MDA		Click here to calculate
HE		
HAL		

(b) Calculate VSDA using formula 4-8:

Formula 4-8. Visual Segment Descent Angle (VSDA).		
$$VSDA = atan\left(\frac{r}{c}\cdot ln\left(\frac{r+HAL+HCH}{r+HCH}\right)\right)\cdot\frac{180}{\pi}$$ Where: c = MAP to Helipoint Distance (ft); HAL = Formula 4-7 output; HCH = Heliport Crossing Height		
atan(r/c*ln((r+HAL+HCH)/(r+HCH))*180/π		
Calculator		
c		Click here to calculate
HAL		
HCH		
VSDA	°	

(c) Calculate visual segment length from the VSRL to a point 250 ft below MDA (VSL_{250}) using formula 4-9.

Formula 4-9. Visual Segment Length (VSL_{250}).		
$$VSL_{250} = \frac{\left(r\cdot ln\left(\frac{r+a}{r+HE}\right)\right)}{tan\left((VSDA-1)\cdot\frac{\pi}{180}\right)}$$ Where: HAL = Formula 4-7 output; a = HAL-250 (MSL); HE = Heliport elevation; VSDA = Formula 4-8 output		
(r*ln((r+a)/(r+HE)))/tan((VSDA-1)*(π/180))		
Calculator		
HAL		Click here to calculate
HE		
VSDA	°	
VSL_{250} (ft)		

e. No Established VSDP. Where no VSDP has been established, apply the principles of Order 8260.3, Volume 1, paragraph 253. Locate the VSDP on the FAC at the point where the VGSI on-glide-slope beam intersects the MDA. The recommended VSDP on-glide-slope descent gradient/angle is 639 ft/NM (6 degrees). The **maximum** angle is 7.5 degrees (USA

maximum descent gradient/angle is 478 ft/NM (4.5 degrees) without a waiver). Where a VGSI facility is installed, the VSDP OCS inclines upward from the VSRL at an angle 1.0 degree below the aiming angle of the on-glide-slope beam. Where no VGSI facility is installed, the VSDP OCS rises 1 degree below the VSDA. Publish the VSDP as an ATD from the MAP. The **minimum** HCH is 5 ft. The **maximum** HCH is 20 ft unless approved by Flight Standards. Calculate the VSDP distance (D) from the helipoint using formula 4-10.

Formula 4-10. Distance from Helipoint (D).

$$D = \frac{r \cdot \ln\left(\frac{r + HAL + HE}{r + HE}\right)}{\tan\left(VSDA \cdot \frac{\pi}{180}\right)}$$

Where:

HAL = Formula 4-7 output
HE = Heliport elevation
VSDA = Formula 4-8 output

(r*ln((r+HAL+HE)/(r+HE)))/tan(VSDA*(π/180))

Calculator

HAL		Click here to calculate
HE		
VSDA	°	
D (ft)		

5. Special IFR Approach to a VFR Heliport (IVH) (Proceed Visually). The special procedure provides a measure of obstruction protection/ identification along the visual track from a MAP to a specific VFR heliport. The visual segment is based on the premise that the pilot will maintain level flight at the MDA until the helicopter is in a position to initiate a descent to the helipoint. Where obstacles preclude an immediate descent at the MAP to the FATO, establish an ATD fix to provide a descent point to the FATO. When an amended procedure no longer meets the criteria in this paragraph, a PinS procedure applying the criteria in chapter 4, paragraph 7 may be published. Compute the distance for the Remote Altimeter Setting Source (RASS) adjustment for the MDA and stepdown altitudes for the IVH approach procedures from the source to the MAP.

a. Alignment. The IVH visual segment connects the MAP to the helipoint. The **optimum** IVH visual segment is aligned with the FAC. The course change at the MAP must not exceed 30 degrees.

b. Area.

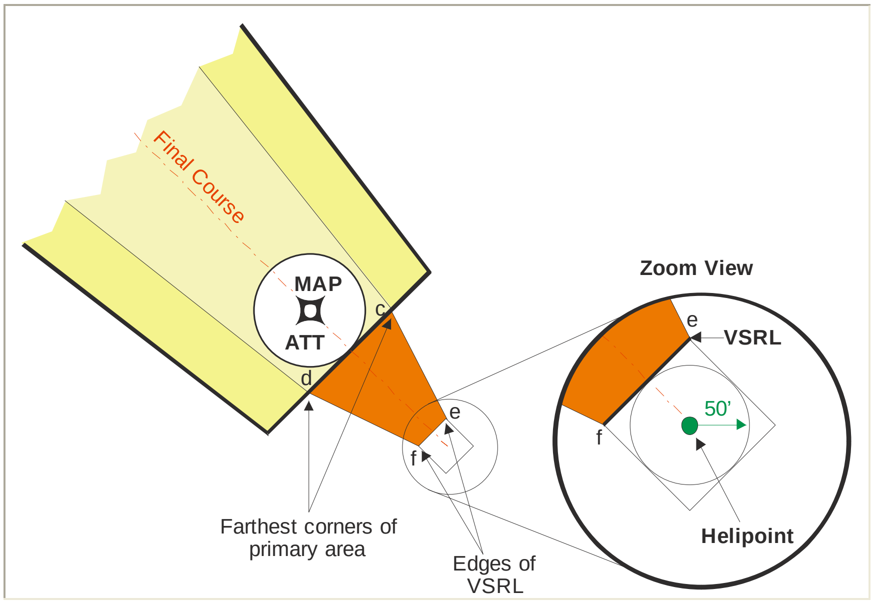
(1) Length. The IVH visual segment OEA begins at the earliest MAP ATT and ends at the VSRL. The IVH visual segment OEA **maximum** length is 10,560 ft (2 SM), measured from the MAP plotted position to the helipoint. The **optimum** MAP/ATD fix to helipoint distance is

3,949 ft (0.65 NM). The **minimum** distance from the MAP/ATD fix to the helipoint is 3,342 ft (0.55 NM).

(2) Width. The IVH visual segment splay begins at the VSRL. It splays from the VSRL endpoints toward the MAP until the visual segment OEA reaches the appropriate construction width [see chapter 4, paragraph 5b(2)(a) or 5b(2)(b)].

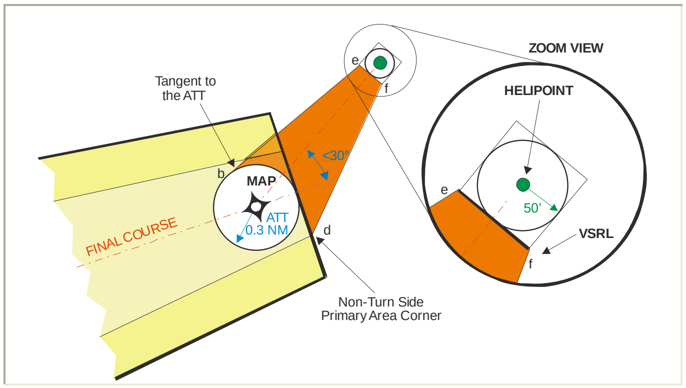
(a) Straight Course Construction. Connect the final primary area outer edges (cd) to the VSRL outer edges (ef) (see figure 4-8).

Figure 4-8. Straight Visual Segment OEA.



(b) Turn at the MAP Construction. Refer to figure 4-9, and connect the tangent on the turn side (b) of the MAP nearest the heliport to the VSRL at point (e). This connection extends the turn-side area and identifies whether final secondary areas lie within the visual OEA (The MDA must provide primary ROC within this area). Connect the non-turn-side primary area corner (d) to the VSRL at point (f).

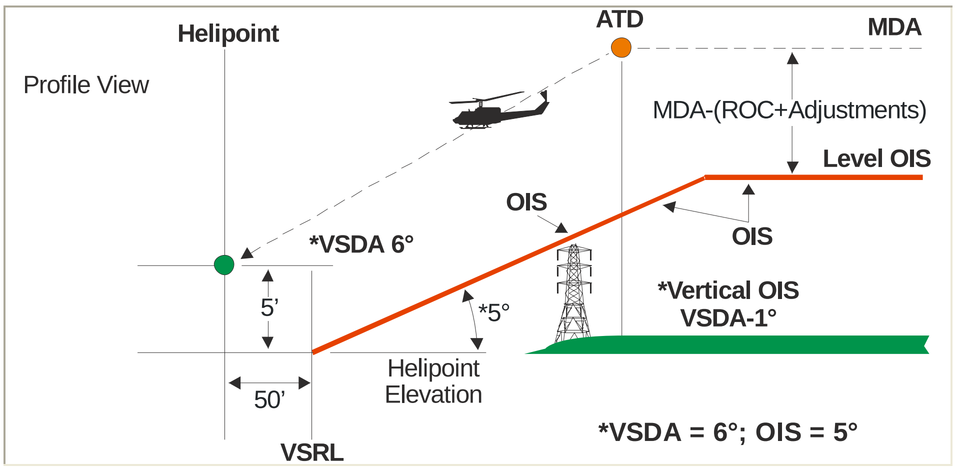
Figure 4-9. Visual Segment with Turn at MAP OEA.



(3) Visual Segment OIS Evaluation. Apply chapter 4, paragraph 3a for the IFR segment OCA and ROC. Apply chapter 4, paragraph 3a(3) in constructing the descent gradient/angle in the IFR segment.

c. Visual Segment Descent Angle (VSDA). The VSDA is a developer-specified angle extending from a point 5 to 20 ft directly above the helipoint to the MDA. The VSDA must cross the MDA between the helipoint and the MAP. The **maximum** VSDA is 7.5 degrees, **optimum** is 6.0 degrees, VSDA angles higher than 7.5 degrees require Flight Standards Service approval. (see figure 4-10).

Figure 4-10. VSDA and OIS.



d. Visual Segment OIS. The OIS begins at the VSRL and extends upward toward the MAP at an angle of (VSDA – 1 degree). The OIS rises to the point it reaches an altitude equal to the MDA minus the ROC and adjustments. Where the MAP is beyond this point, the OIS becomes a level surface to the MAP plotted position. Measure obstacles using the shortest distance to the VSRL. Obstacles should not penetrate the OIS; if they penetrate in the initial evaluation, take one of the following actions, listed in preferential order (see figure 4-11):

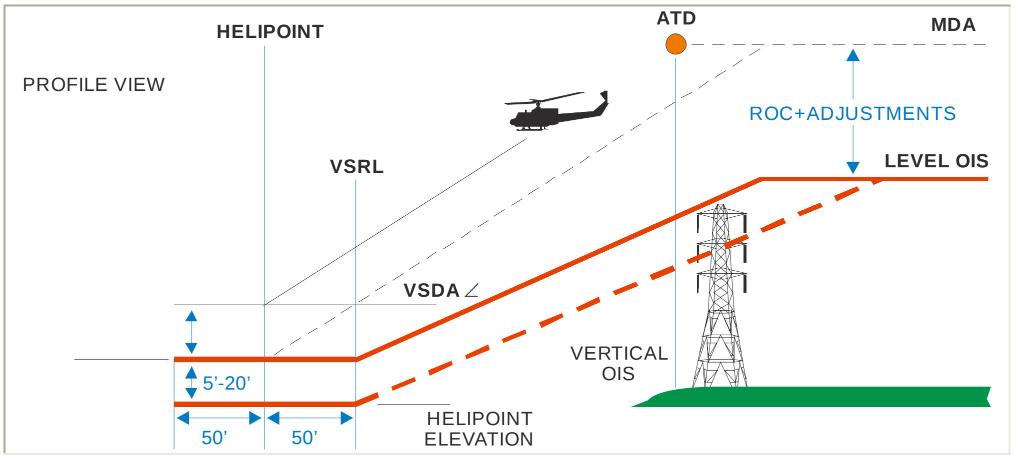
(1) Remove or adjust obstacle location and/or height to eliminate the penetration, or

(2) Raise the VSDA to achieve an OIS angle that clears the obstacle, (7.5 degrees **maximum** without Flight Standards Service approval), or

(3) Identify the obstacle with the greatest penetration. Raise the MDA the penetration amount and round to the next higher 20-ft increment. Initiate action to have the obstacle marked and lighted, if feasible. Depict all obstacles on the approach chart that penetrate the OIS and include in required training.

(4) Raise the HCH to ≤ 20 ft provided the height is consistent with the helicopter's ability to hover out of ground effect. When this procedure is applied, raise the OIS origin above the helipoint elevation by the amount that the HCH is increased (see figure 4-11).

Figure 4-11. VSDA and OIS.



6. Special IFR Approach to A VFR Runway (IVR) (Proceed Visually). This special procedure provides protection/identification along a visual track from the MAP to a specific point on a VFR runway (see figure 4-12 example). This procedure requires the training and equipment contained/specified in an OpSpec or letter of authorization (LOA). This procedure must meet all IVH (Proceed Visually) procedure requirements and the following additional requirements:

a. Location on the runway. The helipoint (aiming point) may be located at any point on a runway centerline, but should be at least a distance of (1.5 * Rotor Diameter) from the end of the usable runway on centerline. The runway is not required to be marked with heliport markings. The visual track from the MAP to the final approach area helipoint must be charted.

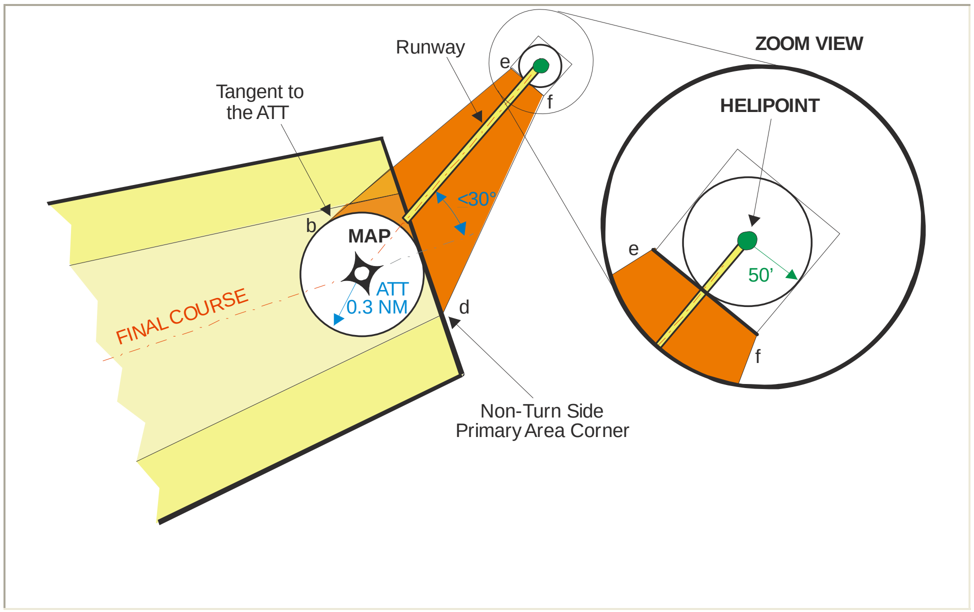
b. Alignment. The **optimum** FAC and visual flight path is aligned with the extended runway centerline, with the MAP at the threshold. The FAC must be aligned within 30 degrees of the extended runway centerline. See paragraph 5 and figures 4-8, 4-9 and 4-12 for OEA construction examples.

c. Day operations. An **'acceptable'** visual segment day flight evaluation for flyability and OIS obstacle penetration must be completed.

d. Night operations. An '**acceptable**' visual segment night flight evaluation for flyability must be completed. This evaluation must confirm the runway lighting system is visible from the MAP.

e. Helipoint Location. The runway final approach area about the heliport must be clearly viewable from the MAP.

Figure 4-12. IFR to a VFR Runway.



7. PinS Approach (Proceed VFR). The VFR segment on a PinS (Proceed VFR) approach procedure provides a measure of obstacle protection/identification to allow a safe transition from IFR to VFR flight. The area is not intended to support IFR descent.

Apply Order 8260.3, Volume 1, chapter 11 pertaining to PinS approach criteria, except no requirement exists for a MAP to be located beyond 2,600 ft of the helipoint. A PinS (Proceed VFR) procedure may be developed to a heliport, multiple heliports, or a geographical area not associated with a specific heliport. Refer to chapter 2, paragraph 3 to determine whether procedures are 'Specials.' Compute the distance for the Remote Altimeter Setting Source (RASS) adjustment for the MDA and stepdown altitudes for the PinS approach procedures from the source to the MAP.

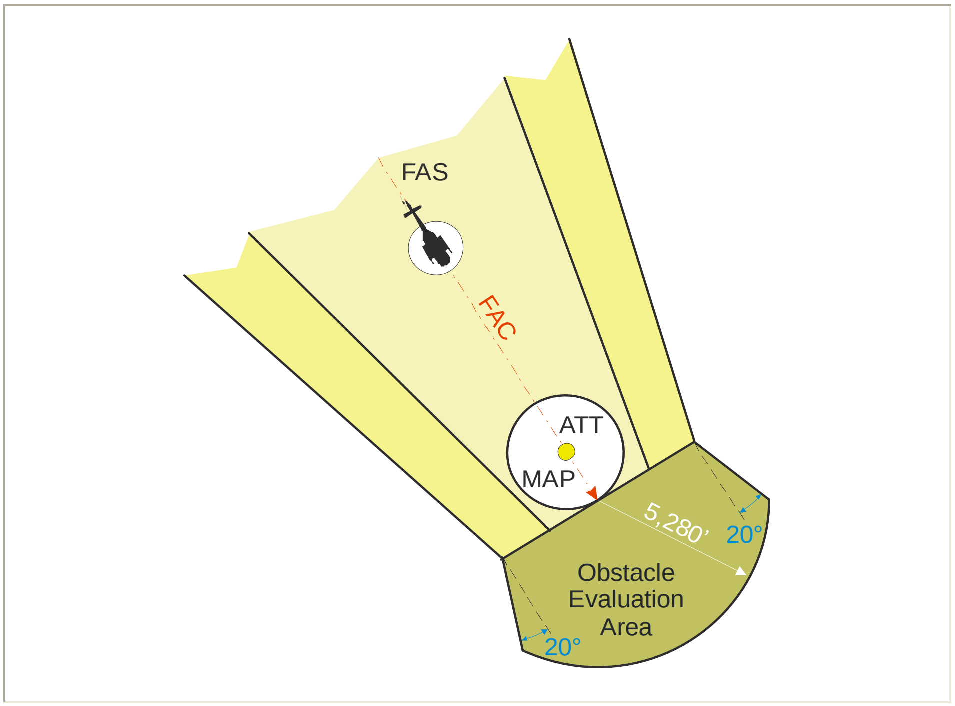
a. Alignment. The PinS visual segment is a 5,280 ft-radius arc segment centered at the FAC and the latest MAP ATT intersection.

b. Area. The PinS OEA is a 5,280 ft-radius arc segment centered at the FAC and the latest MAP ATT intersection. The arc segment is laterally bounded by 20 degree splay lines (relative the FAC-extended), originating at the FAS secondary boundaries and the latest MAP ATT (see figure 4-13).

c. Length. A 5,280 ft radius as described above.

d. PinS visual segment OIS (see chapter 4, paragraph 7e)**.** This surface **must not** be penetrated **except** when a 'special approach procedure' MDA, not providing obstacle clearance in this area, is **mandatory** for mission completion. Obstacles that penetrate the special procedure surface must be charted and included in the required training (AAOs are not charted).

Figure 4-13. PinS (Proceed VFR) VFR Transition Area Obstacle Evaluation (OEA).



e. Obstacle Clearance in the PinS VFR Segment. Add 250 ft of ROC (minus adjustments) to the highest obstacle/terrain within the VFR area and (round to the next higher 20-ft increment). The final MDA is the higher of the MDAs calculated for the final and VFR segments. This does not apply to special approaches (see chapter 4, paragraph 7d).

f. Visibility. The **minimum** final segment visibility is ¾ SM for a height above surface (HAS) of 800 ft and below. Where a HAS exceeds 800 ft, the MINIMUM visibility is 1.0 SM.

8. IFR to an IFR Runway.

a. Configuration and Alignment. The MAP location should provide the best compromise of lowest visibility and VSDA. Except where the alignment is to the RWT, the mandatory MAP location is at the FAC and RCL intersection. Where the alignment is to the RCL, the optimum MAP location is at the RWT, with optional MAP location along the FAC between the PFAF and the RWT.

b. Area. The final OEA begins at the earliest PFAF ATT and ends at the latest MAP ATT, RWT, or a point abeam the RWT, whichever is farthest. Apply chapter 4, paragraph 3a criteria for the IFR segment OEA and ROC (see figure 4-1).

c. Descent Gradient/Angle. Calculate the FAS descent angle from the PFAF altitude at the plotted position of the PFAF to the TCH at RWT. Apply chapter 4, paragraph 3a(4).

d. Visual Segment. Apply Order 8260.3, Volume 1, paragraph 3.3.2.d. Establish a 40 ± 5 ft TCH for runways where no VGSI is installed. Where a VGSI is installed, a final descent gradient and VSDA may be established to coincide with the established gradients/angles for angles of 3.0 angles or more. If the descent gradient/angle cannot be published coincident (within ± 0.20 degrees) and TCH values within 3 ft of the published VGSI glide slope angle, publish a note on the chart.

e. Visibility. See chapter 7, paragraph 1b. Apply Order 8260.3, Volume 1, paragraph 1127. Where obstacles penetrate Order 8260.3, Volume 1 paragraph 3.3.2.d. surfaces, add the chart note: Visibility Reduction by helicopters NA. See Order 8260.19, paragraph 854(i)(3).

> **Note:** When a special procedure has a GPA greater than 5.7 degrees and a TCH higher than 45 ft, Order 8260.3, Volume 1, paragraph 1127 may be applied. Table 25 application is required.

9. WAAS LP Criteria. The WAAS LP criteria apply to the final approach only. For all other segments apply GPS criteria except where noted for a turn at the PFAF, and missed approach constructions that are different. This implementation of WAAS does not include a glidepath function for these procedures. Criteria in this chapter provide a narrower OEA in the IFR FAS and OIS in the visual segment. The segment lengths and descent rate/gradients are the same as chapter 4, paragraph 3. The intermediate segment begins with the same width at the GPS intermediate fix (IF), reference chapter 3, paragraph 1b, tailored to the beginning WAAS FAS width, reference chapter 4, paragraph 9d at the PFAF. Apply chapter 4, paragraph 5 through 7 to design approaches in the visual/visual flight rule (VFR) segments, and apply chapter 4, paragraphs 8 and 9 for the IFR FAS OEA and ROC. Apply an OIS, reference chapter 4, paragraph 5d, with the reduced width, reference chapter 4, paragraph 8d. Apply chapter 4, paragraph 5 for the analysis of the VFR area of a Point in Space (PinS) (Proceed VFR) approach.

Figure 4-17 depicts the basic configuration for determining the Flight Path Alignment Point (FPAP) and fictitious helipoint (FHP) coordinates. Locate the FHP 2,600 ft from the MAP. The FPAP is a point defined by the World Geodetic System 1984 (WGS-84) latitude, longitude, and is located 9,023 ft from the FHP.

a. Minimums. Apply chapter 7.

b. Use The Following Steps for WAAS LP Procedure Construction:

Step 1: Determine the FAS course alignment, MAP, FHP, and FPAP coordinates.

Step 2: Calculate the distance (ft) from the FHP to the PFAF (D_{PFAF}) using formula 4-11. Calculate the primary and secondary area widths at any distance from FHP to the earliest point the PFAF can be received using formulas 4-11 and 4-13 (see figure 4-14).

Formula 4-11. LP PFAF (D_{PFAF}).		
$$D_{PFAF} = \frac{\ln\left(\frac{r+alt}{r+FHP_{elev}+HCH}\right)\cdot r}{\tan\left(\theta\cdot\frac{\pi}{180}\right)}$$ Where: alt = minimum intermediate segment altitude; FHP_{elev} = FHP MSL elevation; HCH = HCH value; θ = glidepath angle		
(ln((r+alt)/(r+FHP_{elev}+HCH))*r)/tan(θ*π/180)		
Calculator		
FHP_{elev}		Click here to calculate
HCH		
θ	°	
alt		
D_{PFAF} (ft)		

Step 3: After constructing the IFR final trapezoid area, analyze the FAS by determining the controlling obstacle within the IFR final segment by applying the ROC in chapter 4, paragraph 9b and determining the minimum descent altitude (MDA).

Step 4: When constructing an IFR to a VFR heliport procedure (IVH, Proceed Visually), or an IFR approach to a VFR runway procedure (IVR, proceed visualy), apply chapter 4 criteria for the visual segment, but construct the narrower OIS in accordance with chapter 4, paragraph 9g.

Step 5: When constructing a PinS (Proceed VFR) approach, apply chapter 4 criteria for the VFR segment and adjust the MDA of the IFR segment after an analysis of the VFR segment if required.

Step 6: Construct the missed approach using chapter 5.

c. Determine FAS Course Alignment, FPAP and FHP Coordinates. The FAS course determines the positional relationship between the FPAP and the FHP. Calculate the FPAP latitude and longitude coordinates using the MAP as a starting point after determining the procedure final approach course (FAC). Use the direct program and extend the FAS course as an azimuth at a distance of 2,600 ft from the MAP to determine the FHP coordinates. Extend this course 9,023 ft beyond the FHP to calculate the FPAP coordinates (see figure 4-14 and table 4-1).

Figure 4-14. FPAP and FHP Coordinates.

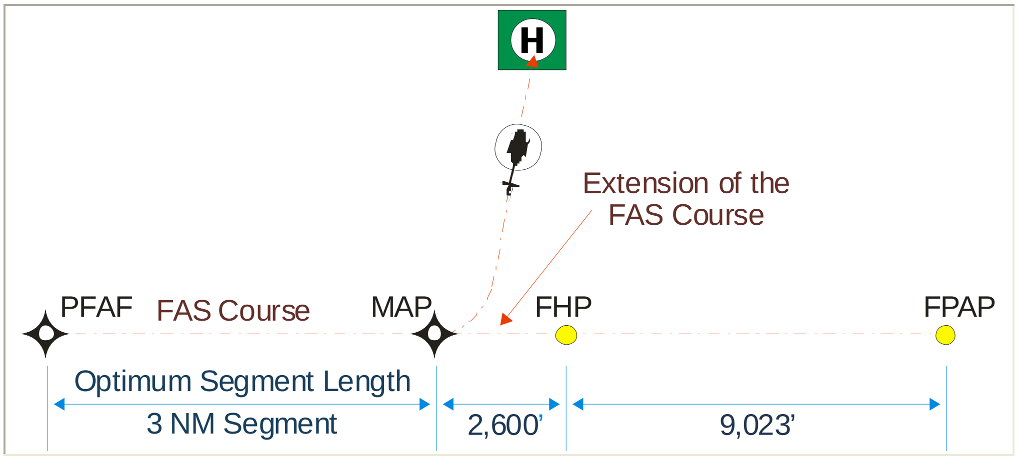


Table 4-1. FPAP Information.

FPAP Distance from FHP	± Splay	± Width	Length Offset
9,023 ft	2.0°	350 ft (106.75 m)*	0

*Round result to the nearest 0.25 m.

d. Area. The FAS OEA begins at the earliest PFAF position and ends at the MAP latest ATT (see figure 4-16). The PFAF and MAP ATT is ±40 m. Apply 250 ft of ROC in the primary area. The secondary area ROC is 250 ft at the primary boundary tapering uniformly to zero at the outer edge. The beginning primary area width nearest the FHP is 867.79 ft, and the secondary areas are 468.60 ft (see figures 4-15b and 4-16). Calculate the primary and secondary widths at any point between FHP and PFAF using formulas 4-12 (primary) and 4-13 (secondary).

(1) Length. The **standard** IFR final segment length PFAF to MAP is 3 NM but is also determined by descent gradient. The **minimum** length is 2 NM and the **maximum** length is 50,000 ft. (see figure 4-15a).

Figure 4-15a. WAAS LP Final Segment.

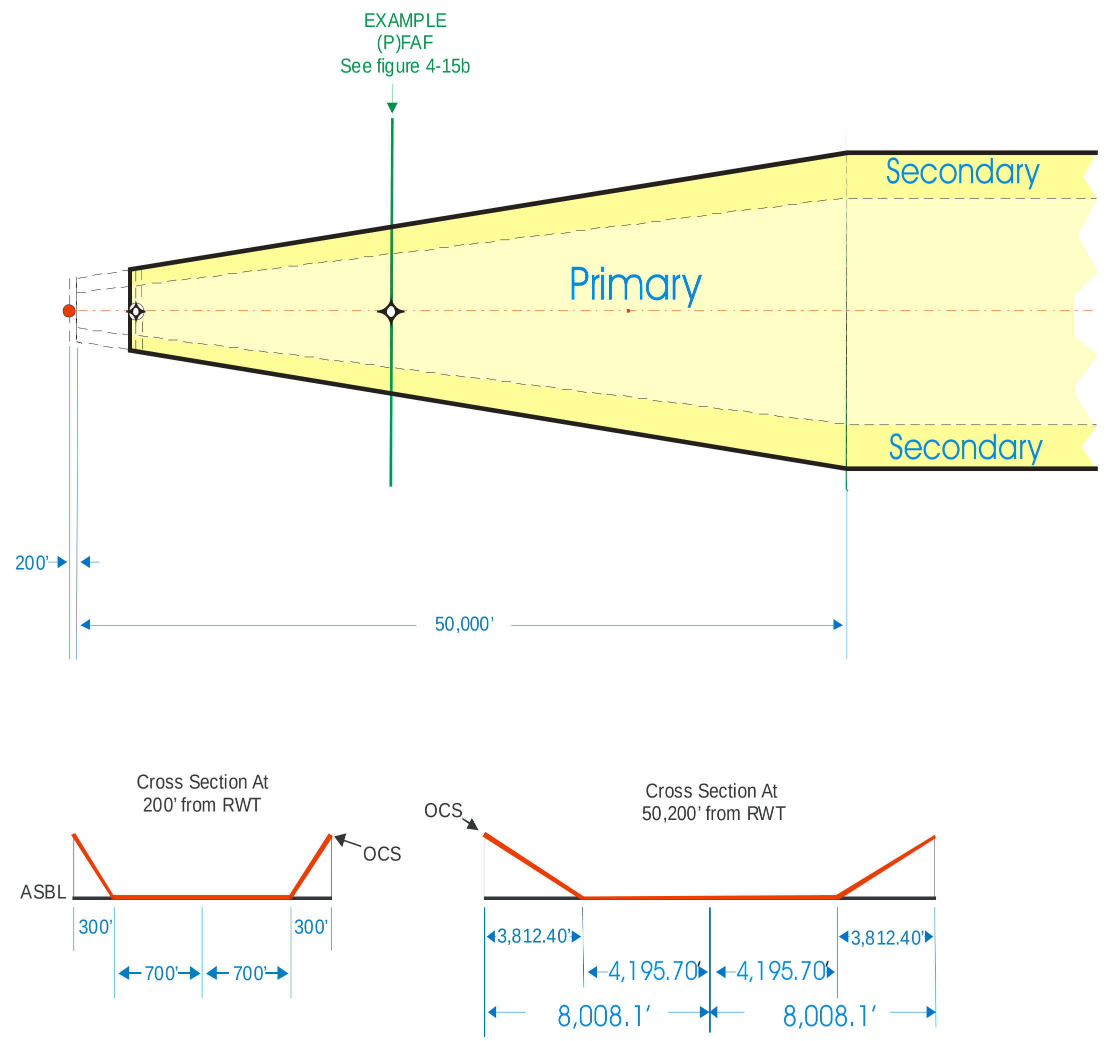


Figure 4-15b. WAAS LP Final Segment Construction.

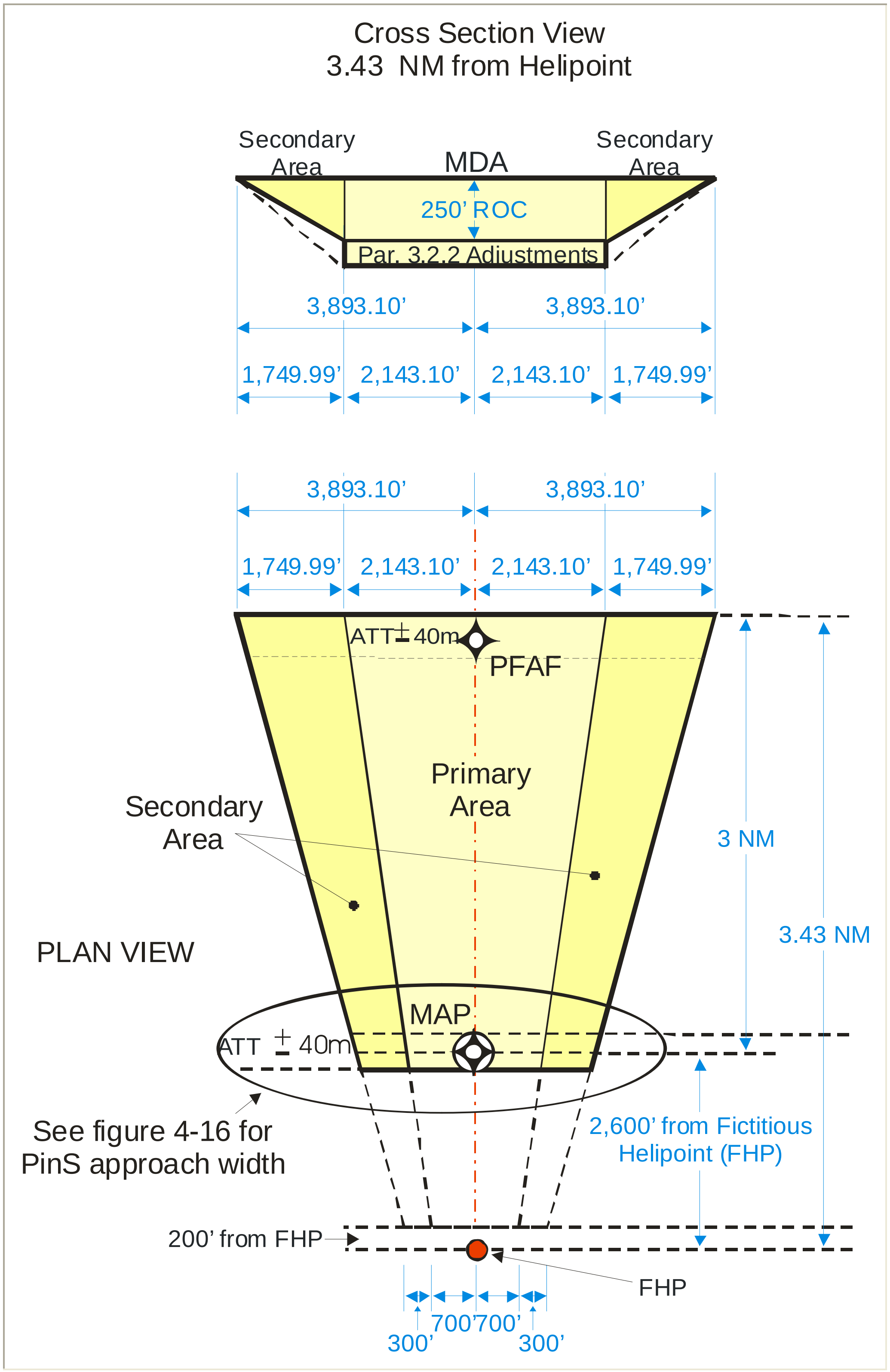
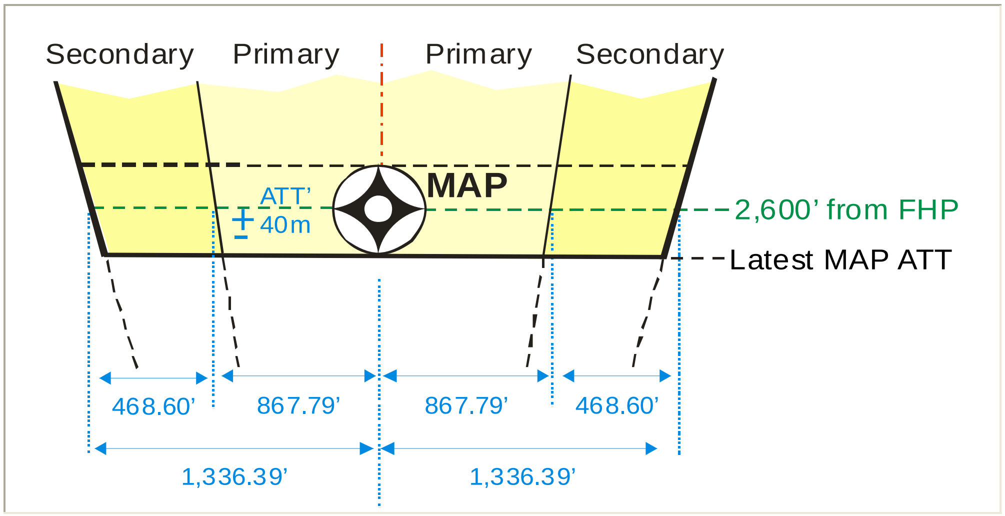


Figure 4-16. OCS Beginning Width, IFR to VFR Heliport and Copter PinS FAS at 2,600 ft from FHP.



(2) The primary area width (D_P) each side of FAC at its origin (2,600 ft from FHP) is 867.79 ft. The primary area expands uniformly to 3,495.70 ft from FAC at a point 50,200 ft from FHP. From 50,200 ft outward, the OEA is linear (boundaries parallel the centerline). The OEA begins at the earliest PFAF ATT and ends 2,600 ft from the FHP (MAP latest ATT). Calculate primary area half-width at any point in final using formula 4-12 (see figures 4-15a, 4-15b, and 4-16).

Calculate the perpendicular distance (ft) D_p from FAC to the primary area boundary at any distance (d_{FHP}) using formula 4-12:

Formula 4-12. ½ Width of Primary (D_p).

$$D_P = 1/2 \text{ Primary Area Width (ft)} = 0.0699139\,(d_{FHP} - 200) + 700$$

d_{FHP} = Distance (ft) from FHP, along course

$0.0699139*(d_{FHP}-200)+700$

Calculator

d_{FHP}		Click here to calculate
D_P (ft)		

(3) The perpendicular distance from FAC to outer secondary boundary (D_s) is 1,336.39 ft at the origin, and expands uniformly to 7,008.1 ft at 50,200 ft from the FHP (see figures 4-15a, 4-15b, and 4-16). Calculate D_S (ft) using formula 4-13.

Formula 4-13. Perpendicular Distance (D_s).		
D_S = Secondary Boundary Dist. (ft) = 0.140162 (d_{FHP} - 200) + 1000 Where: D_S = Course to Outer Secondary Distance (ft) d_{FHP} = Distance from FHP (ft), along course		
0.140162*(d_{FHP} – 200) + 1000		
Calculator		
d_{FHP}		Click here to calculate
D_S (ft)		

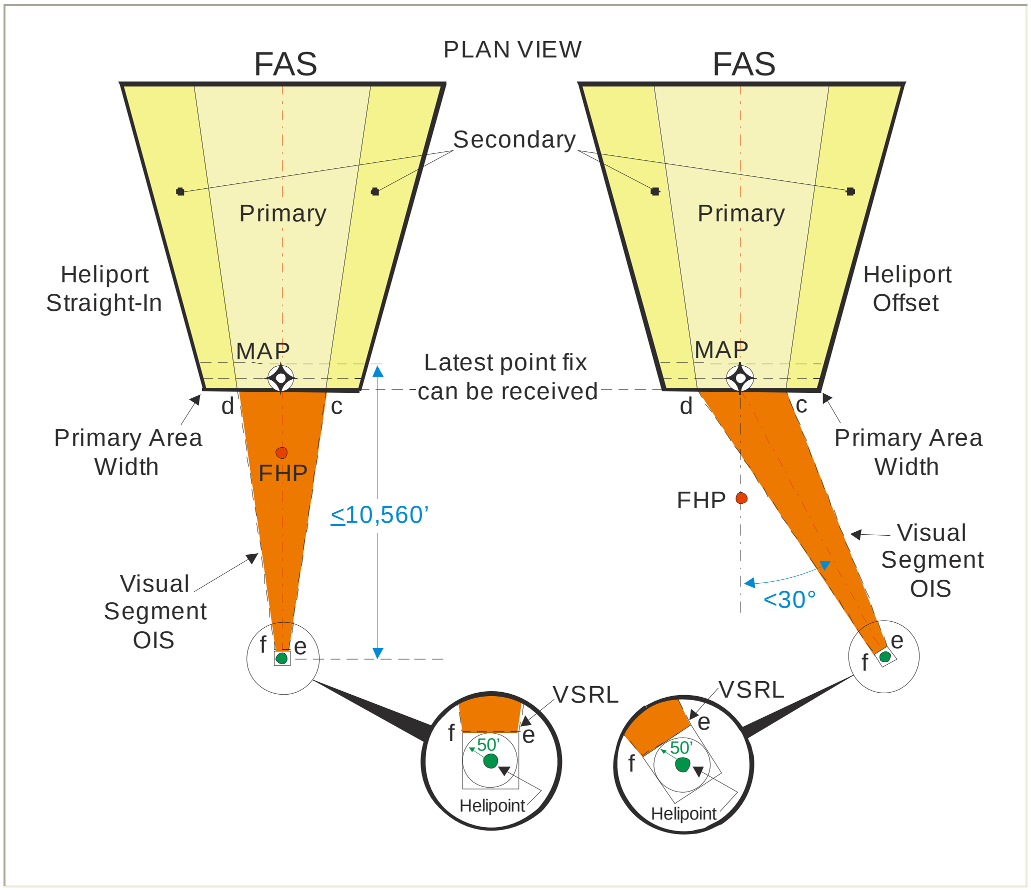
e. Required Obstacle Clearance (ROC). Primary ROC is 250 ft. The MDA can be no lower than the controlling obstacle height adjusted for obstacle accuracy tolerance (see Order 8260.19, appendix 2) plus the ROC value plus adjustments rounded to the next higher 20 ft-increment. Calculate secondary area ROC using formula 4-14.

Formula 4-14. Secondary Area ROC ($ROC_{secondary}$).		
$ROC_{secondary} = (250+adj)\cdot\left(1-\frac{d_{primary}}{W_S}\right)$ Where: adj = TERPS para 3.2.2 adjustments $d_{primary}$ = perpendicular distance (ft) from primary area edge W_S = Secondary Area Width (ft)		
(250+adj)*(1-$d_{primary}$/W_s)		
Calculator		
adj		Click here to calculate
$d_{primary}$ (ft)		
W_s (ft)		
$ROC_{secondary}$		

f. FAS Descent Angle/Gradient. Apply chapter 4, paragraphs 3a(4) and 3a(5).

g. IFR Approach to a VFR Heliport (IVH) or IFR to a VFR Runway (IVR). Apply chapter 4, paragraphs 5 through 7 and the criteria in this chapter for the IFR final segment OEA. Construct the IFR FAS by applying chapter 4, paragraph 9. The OIS width is like the IFR final segment primary area width at the latest point the MAP can be received (± 867.79 ft) then narrows to the VSRL width (see figure 4-17).

Figure 4-17. Straight and Turn at the MAP OIS.



h. PinS Approach. Apply chapter 4, paragraph 9 to determine a preliminary MDA based on the FAS OEA. Apply chapter 4, paragraph 7 and 7e for the VFR segment analysis. The final MDA may require adjustment based on the VFR segment for a public procedure.

Chapter 5. Missed Approach

1. General.

a. Missed Approach (MA) Construction.

(1) Speed. Apply 70 KIAS for civil procedures (see chapter 2, paragraph 1) and 90 KIAS for military. Apply wind values (see chapter 2, formula 2-3b) and bank angles (see chapter 2, table 2-4).

(2) Optimum Flight Path. The missed approach segment ends at a holding point designated by a missed approach holding fix (MAHF). **Optimum** routing is straight ahead to a direct entry into holding at the MAHF. If the MA routing terminates at a "T" IAF, **optimum** MA holding pattern alignment is with the initial inbound course, with either a teardrop or direct entry into holding (see figure 5-1a).

Note: USA: Develop and annotate an alternate RNAV(GPS) MA procedure when requested.

b. Obstacle Clearance Standard. Calculate the nominal OCS slope ($MA_{OCSSLOPE}$) associated with a given missed approach climb gradient using chapter 2, formula 2-15. See chapter 2, paragraph 17 for Missed Approach Conventions.

c. Missed Approach Section 1 (MAS-1). Section 1 begins at earliest MAP along-track tolerance (ATT) and extends to the start-of-climb (SOC), or the point where the aircraft is projected to cross 400 ft above airport/heliport elevation, whichever is the greatest distance from MAP. See figure 5-1b for MA segment point and line designations. Figure 5-2 depicts the Section 1/Section 2 (partial), OCS plan and profile view beginning at an altitude of MDA minus 100 ft plus adjustments (see chapter 4 for greater final segment detail).

(1) Length.

(a) Flat Surface Length (FSL).

1 LNAV. Section 1 flat surface begins at CD (0.3 NM prior to the MAP) and extends (distance FSL feet) to JK.

2 LP. Section 1 flat surface begins at CD [40 meters prior to the MAP] and extends (distance FSL feet) to JK.

Step 1: Calculate the FSL value using formula 5-1. Use chapter 4, final segment formulas 4-1a, (LNAV primary and total), and 4-12 (LP primary), and 4-13 (LP Secondary distance) to determine MAS starting widths.

Formula 5-1. Flat Surface Length (FSL).		
$$FSL = 8 \cdot \frac{\frac{1852}{0.3048}}{3600} \cdot \left(\left(V_{KIAS} \cdot \frac{171233 \cdot \sqrt{(288+15) - 0.00198 \cdot MDA}}{(288 - 0.00198 \cdot MDA)^{2.628}} \right) + 10 \right) + 2 \cdot ATT$$		
8*(1852/0.3048/3600)*((V_{KIAS}*(171233*((288+15)-0.00198*MDA)^0.5)/ (288-0.00198*MDA)^2.628)+10)+2*ATT		
Calculator		
V_{KIAS}		Click here to calculate
MDA		
ATT (ft)		
FSL(ft)		

Note: FSL time is 3 seconds reaction, and 5 seconds delay.

(2) Section 1 end location (AB).

(a) MDA ≥ 400 ft above airport/heliport elevation. Locate AB coincident with JK.

(b) MDA < 400 ft above airport/heliport elevation. Locate AB at $\frac{1852}{(0.3048 \cdot CG)}$ feet beyond JK for each foot of altitude needed to reach 400 ft above airport/heliport/surface elevation. The surface between JK and AB is a rising slope commensurate with the standard rate of climb (400 ft/NM). Find the appropriate CG-related slope using chapter 2, formula 2-15.

(c) Required/assigned turning altitude > 400 ft above airport/heliport elevation. Locate AB and apply the surface described in chapter 5, paragraph 1c(2)(b) until reaching the assigned turning altitude.

(3) Width. LNAV and LP.

(a) LNAV. Splay each secondary area outer boundary line outward 15 degrees relative to the missed approach course (MAC) from the secondary area outer edge at CD (0.3 NM prior to MAP) until it reaches a point 2 NM from MAC. Splay the primary area boundary uniformly outward from the primary area edge at CD to reach 1.5 NM from MAC at the same distance the secondary reaches full width. Calculate the distance from MAC to the MAS-1 OEA primary and outer secondary boundary at any distance from CD using formula 5-1a. Calculate final primary and secondary widths at CD using chapter 4, final formula 4-1a.

(b) LP. Splay each secondary area outer boundary line outward 15 degrees relative to the MAC from the secondary area outer edge at CD (40 meters prior to MAP) until it reaches a point 2 NM from MAC. Splay the primary area boundary uniformly outward from the primary area edge at CD to reach 1.5 NM from MAC at the same distance the secondary reaches full width. Calculate the distance (ft) from MAC to the MAS-1 OEA primary and outer secondary boundary at any distance from CD using formula 5-1a. Calculate final primary and secondary widths at CD using chapter 4, final segment formulas 4-12 and 4-13.

Formula 5-1a. LNAV/LP Section 1 Primary & Secondary Width.

$$MAS_{Yprimary} = d \cdot \frac{\tan\left(15 \cdot \frac{\pi}{180}\right) \cdot (1.5 \cdot NM - W_P)}{2 \cdot NM - W_S} + W_P$$

$$MAS_{Ysecondary} = d \cdot \tan\left(15 \cdot \frac{\pi}{180}\right) + W_S$$

Where d = along-track distance (ft) from the cd line ≤ 45352.743
NM = 1852/0.3048
W_p = Primary Start Width (ft) (final formula)
W_s = Secondary Start Width (ft) (final formula)

$MAS_{Yprimary}$= d*((tan(15*π/180)*(1.5*1852/0.3048-W_P))/(2*1852/0.3048-W_S))+W_P
$MAS_{Ysecondary}$= d*tan(15*π/180)+W_S

Calculator

d		Click here to calculate
W_P		
W_S		
$MAS_{Yprimary}$		
$MAS_{Ysecondary}$		

(4) Obstacle Clearance Section 1.

(a) The nominal MAS-1 OCS is a flat surface. The MSL surface height (HMAS) is equal to the MDA minus 100 ft plus adjustments (see formula 5-1b). No obstacle may penetrate this surface.

(b) Where Section 1 extends beyond SOC (JK), no obstacle may penetrate the CG-associated OCS slope between SOC and AB. Find helicopter altitude at AB using formula 5-1c.

Formula 5-1b. HMAS.

$$HMAS = MDA - (100 + adj)$$

Where:
adj = precipitous terrain, remote altimeter (only if full time), and excessive length of final adjustments

MDA-(100+adj)

Calculator

MDA		Click here to calculate
adj		
HMAS		

Formula 5-1c. Section 1 End Helicopter Altitude ($Copter_{AB}$).		
$$Copter_{AB} = (r + MDA \text{ or } DA) \cdot e^{\frac{AB_{NM} \cdot CG}{r}} - r$$ Where: AB_{NM} = SOC to <u>AB</u> distance (NM); CG = applied climb gradient (ft/NM)		
(r+(MDA or DA))*e^((AB$_{NM}$*CG)/r)-r		
MDA or DA		Click here to calculate
AB_{NM}		
CG		
$Copter_{AB}$		

d. These criteria cover two basic MA constructions:

- Straight missed approach
- Turning missed approach

Note: These construction methods accommodate traditional combination straight and turning missed approaches.

(1) The section 2 obstacle evaluation area (OEA) splays 15 degrees relative to the nominal track to reach full width (see figure 5-3). The OEA ends at the MA Holding Fix (MAHF) latest ATT. Apply the Section 2 standard MA OCS slope beginning from <u>AB</u> . Calculate MA OCS slope values using chapter 2, formula 2-15.

Note: All references to 'standard MA OCS slope' and/or use of '20:1' refer to chapter 2, formula 2-15 output, with an input climb gradient (CG) of 400 ft/NM.

(2) Where a higher than standard CG (400 ft/NM) is required, apply the CG and the CG-related OCS from the SOC. Apply secondary areas as specified in this chapter. Measure the 4:1 secondary OCS perpendicular to the nominal track, measured from the primary boundary, or perpendicular to the primary boundary when considering arcs, diagonal corner-cutters, etc.

(3) Locate the MAHF within 25 NM of the ARP/HRP. Determine **minimum leg length** for course changes following the first fix after the MAP using the greater distance from chapter 2, formulas 2-7, 2-8, and 2-9, climb distance required, and chapter 3, table 3-1.

(4) Design MA holding for 90 KIAS, or the appropriate restricted speed.

2. Straight Missed Approach. The straight missed approach course (MAC) is a continuation of the final approach course (FAC). The straight MA section 2 OEA begins at secton 1 end (<u>AB</u>) and splays at 15 degrees relative to the nominal track until reaching full primary and secondary width (0.5-1.5-1.5-0.5). Apply the section 2 standard OCS, or the OCS associated with a higher CG, beginning at <u>AB</u> from the section 1 end OCS elevation. (When the increased CG is no longer required, revert to the section 2 standard OCS). Determine primary OCS elevation at an obstacle by measuring the along-track distance from AB to a point at/abeam the obstacle. Where the obstacle is located in the secondary area, apply the primary OCS slope to a point abeam the obstacle, then apply the 4:1 secondary slope (perpendicular to the track) from the primary boundary to the obstacle (see chapter 5, figures 5-3, 5-4).

3. Turning Missed Approach. Apply turning criteria when requiring a turn at or beyond SOC. Where secondary areas exist in section 1, they continue to full width in section 2. Terminate turn-at-fix turn-side secondary areas not later than the early turn point. Do not apply turn-side secondary areas for turn-at-altitude construction. The terms 'inside turn' and 'outside turn' are used to reduce verbiage in describing turn associated construction and relationships. Where required, alternate construction steps (indicated by Step #ALT) are provided to supplement or replace the primary step.

There are two types of turn construction for the first MA turn:

- Turn at an altitude (see chapter 5, paragraph 3a):
    - Always followed by a DF leg ending with a DF/TF connection

- Turn at a fix (see chapter 5, paragraph 3b):
    - Always followed by a TF leg ending with a TF/TF connection.
    - May be followed by an RF leg (which requires advanced avionics) when the initial straight leg has reached full width, ending with an RF/TF or RF/RF connection. RF turn initial fix must be located where the aircraft is at least 500 ft above airport elevation.

Following a turn, the minimum segment length must be the greater of:

- The minimum length calculated using chapter 2, formulas 2-7, 2-8 and 2-9.

- The distance from previous fix to the intersection of the 30-degree converging outer boundary line extension and the nominal track, (plus segment end fix DTA).

Minimum DF leg length must accommodate 6 seconds (minimum) of flight time based on either 70 KIAS or 90 KIAS, as appropriate, applied between the wind spiral (WS)/direct-to-fix-line tangent point, and the earliest maneuvering point of the DF/TF fix. Convert to TAS using chapter 2, formula 2-3a and the MAHF altitude.

a. Turn At An Altitude. Apply turn-at-an-altitude construction unless the first MA turn is at a fix. Since pilots may commence the MA at altitudes higher than the MDA and helicopter climb rates differ, turn-at-an-altitude construction protects the large area where turn initiation is expected. This construction also provides protection for 'turn as soon as practicable' and combination straight and turning operations. When a required turning altitude exceeds the minimum turning altitude (typically 400 ft above the airport, heliport, or height above surface), specify the turning altitude in a 100-ft increment. Where operationally required, 20-ft increments may be applied.

Note: 'Turn as soon as practicable' includes, but is not limited to operational suitability, flight characteristics/capability, appropriate altitude, positioned at or beyond the MA early ATT, as well as the feasibility, workability, and viability of the intended maneuver.

When a turn at altitude MA, (low MDA, turn at less than 400 ft above airport/heliport or height above surface, etc.) is required, Flight Standards Approval is required.

Track guidance is assumed throughout the operation; therefore, dead reckoning (DR) segments are not considered. Apply turning MA criteria whenever the MAC differs from the FAC. The following applies:

- Section 1/Section 2 connection is depicted in chapter 5, figure 5-5 for a minimum altitude turn-at-altitude MA. The CD is the earliest the MAP can be received. AB is the SOC (chapter 5, figure 5-6 depicts higher than minimum altitude turns).

- Section 2 and section 1 connect at AB.

- Construct section 2 outside-turn boundaries using WS vice specified radii. Construct outside boundaries in relation to these WS and late turn track (see chapter 5, figures 5-9, 5-13, 5-15).

- Construct inside-turn boundaries in relation to the early turn track (see chapter 5, figures 5-5, 5-6).

- Apply the standard OCS slope (or the assigned CG-associated slope) beginning at AB at AB OCS height. The secondary 4:1 surface rises from the primary OCS.

(1) Turn Initiation Area (TIA). Construct the TIA, a portion of a straight MA, beginning from the earliest MA turn point (CD), and ending where the specified minimum turning altitude is reached, (AB or LL'). Base the TIA length on the climb distance required to reach the turning altitude. The TIA minimum length must place the aircraft at an altitude from which obstacle clearance is provided in section 2 outside the TIA. The TIA boundary varies with length, the shortest B-A-C-D, where AB overlies JK. Where the TIA is contained within section 1, B-A-J-C-D-K defines the boundary. Where the required turn altitude exceeds that supported by section 1, the TIA extends into section 2, (see figure 5-8 and Order 8260.54 for construction examples) and points L'-L-A-J-C-D-K-B define its boundary. In this case, L-L' is the early turn point based on the helicopter climbing at the prescribed CG. Calculate TIA length using chapter 5, formula 5-2a. A 4:1 secondary is depicted on the non-turning side of the primary (see chapter 5, figures 5-6, 5-8, and 5-9).

Step 1: Turn altitude. The turn altitude is either operationally specified (must be at or above altitude required by obstacles) or determined by obstacle evaluation. Evaluate the nominal OCS. If the OCS is penetrated, mitigate the penetration with one or a combination of the following:

- Raise MDA
- Establish a climb gradient that clears the obstacle
- Move MAP
- If the penetration is outside the TIA, consider raising the climb-to altitude

(a) Determine the helicopter required minimum turning altitude:

- Identify the controlling obstacle in section 2 (straight MA)
    - For straight OCS/CG/length options
- Identify the controlling obstacle in section 2, (typically turn-side)
- Find the shortest distance from the TIA lateral boundary to the obstacle
- Apply this distance and the MA OCS slope to find the TIA-to-obstacle OCS rise
- The minimum TIA boundary, (and OCS end elevation) equals the obstacle elevation minus OCS rise
- The minimum turn altitude is the sum of (TIA OCS boundary elevation) and (final ROC), rounded to the next higher 100 ft-increment (where operationally required, 20-ft increments may be applied)

Note 1: TIA lateral boundary is the straight segment (portion) lateral boundary until the required minimum turn altitude and TIA length are established.

Note 2: Repeat Step 1 until acceptable results are obtained.

The specified altitude must equal or exceed the section 1 end altitude. Find section 1 end altitude using chapter 5, formula 5-1c.

Step 2: Calculate TIA length (ft) using chapter 5, formula 5-2a (see chapter 5, figures 5-6 and 5-8).

Formula 5-2a. TIA_{length}.		
$$TIA_{length} = FSL \cdot \frac{r}{(r+MDA)} + \frac{r}{CG} \cdot \frac{1852}{0.3048} \cdot \ln\left(\frac{r+turn_{alt}}{r+MDA}\right)$$ Where MDA = Final MDA CG = Climb Gradient (Standard 400 ft/NM) $turn_{alt}$ = required turn altitude		
FSL*r/(r+MDA)+r/CG*1852/0.3048*ln((r+$turn_{alt}$)/(r+MDA))		
Calculator		
FSL (formula 5-1)		Click here to calculate
MDA		
CG		
$turn_{alt}$		
TIA_{length} (ft)		

Step 3: Locate the TIA end at a distance TIA length beyond CD (from **Step 2**) (LL') where the applied OCS reaches the required TIA end surface elevation (from **Step 1**).

Step 4: Locate the latest turn point, (PP') at distance rr (from chapter 2, formula 2-4a) beyond the TIA end (AB/LL'). See example chapter 5, figures 5-6 and 5-8.

(2) OEA Construction after TIA. The OEA includes areas to protect the earliest and latest direct tracks from the TIA to the fix. Construct the obstacle areas about each of the tracks as described below. See chapter 5, figures 5-9 through 5-15 for various turn geometry construction illustrations.

(a) Early Turn Track and OEA Construction. Where the early turn track from the FAC/CD intersection defines a turn less than or equal to 75 degrees relative to the FAC, the tie-back point is C (see chapter 5, figure 5-5); if the early track defines a turn greater than 75 degrees relative to the FAC, tie-back to point D (see chapter 5, figure 5-7). Where the early track represents a turn greater than 165 degrees (see chapter 5, figures 5-12 and 5-15), begin the early turn track and the 15-degree splay from the non-turn side TIA end + rr (chapter 2, formula 2-4a) (PP').

Step 1: Construct a line (defines the earliest-turn flight track), from the tie-back point to the fix. See chapter 5, figures 5-9, 5-10, 5-14, and 5-15.

Step 2: Construct the outer primary and secondary OEA boundary lines parallel to this line (0.5-1.5-1.5-0.5 segment width). See chapter 5, figures 5-9 and 5-10.

Step 3: From the tie-back point, construct a line splaying at 15 degrees to intersect the parallel boundary lines or segment end, whichever occurs earlier (see chapter 5, figures 5-9 and 5-10).

Note: Apply secondary areas only after the 15-degree splay line intersects the primary boundary line (see chapter 5, figures 5-9, 5-10, 5-13, etc).

Step 3Alt: Where **Step 3** construction provides less than full-width protection at the DF fix, construct the OEA inner boundary with a line splaying from the tie-back point at 15 degrees relative the direct-to-fix line, (or greater where required to provide full-width protection at the DF fix), until it intersects the parallel boundary lines (not later than tangent/tangent-extension to the full-width-arc about the fix), **and** provides full-width protection at or before the DF fix. DF secondary areas begin/exist only where full width primary exists. See chapter 5, figures 5-10, 5-14, and 5-15.

Note: Where excessive splay results (dependent upon various conditions but generally in the 20-25 degree range), consider modifying the segment to avoid protection and/or construction difficulties.

(b) Late Turn Track and OEA Construction. Apply WSs for late-turn outer boundary construction using the following calculations, construction techniques, and bank angles of 11 degrees or 14 degrees, as appropriate.

Step 1: Find the no-wind turn radius (R) using chapter 5, formula 5-2b.

Formula 5-2b. No-Wind Turn Radius (R).		
$$R = \frac{(V_{KTAS} + 0)^2}{\tan\left(Bank_{ANGLE} \cdot \left(\frac{\pi}{180}\right)\right) \cdot 68625.4}$$ Where: V_{KTAS} = True Airspeed, formula 2-3a; $Bank_{ANGLE}$ = Table 2-4 value		
$(V_{KTAS}+0)$^2/(tan($Bank_{ANGLE}$*π/180)*68625.4)		
Calculator		
V_{KTAS}		Click here to calculate
$Bank_{ANGLE}$	°	
R (NM)		

Note: Apply the appropriate indicated airspeed and minimum assigned turn altitude when converting to true airspeed for this application.

Step 2: Calculate the Turn Rate (TR) using chapter 5, formula 5-2c. Maximum TR is 3 degrees per second.

Formula 5-2c. Turn Rate (TR).		
$$TR = \frac{3431 \cdot \tan\left(Bank_{ANGLE} \cdot \frac{\pi}{180}\right)}{\pi \cdot V_{KTAS}}$$ Where: $Bank_{ANGLE}$ = Table 2-4; V_{KTAS} = Formula 2-3a		
(3431*tan($Bank_{ANGLE}$*π/180))/(π*V_{KTAS})		
Calculator		
$Bank_{ANGLE}$	°	Click here to calculate
V_{KTAS}		
TR (˚/Sec)		

Step 2a: Calculate the Turn Magnitude ($Turn_{Magnitude}$) using the appropriate no-wind turn radius and the arc distance (degrees) from turn start (at PP') to the point of tangency with a line direct to the fix.

Step 2b: Calculate the highest altitude in the turn using chapter 5, formula 5-2d (MAHF altitude may be used). Determine subsequent fix altitudes using fix-to-fix direct measurement and 400 ft/NM, (or higher assigned) climb rate.

Formula 5-2d. Highest Altitude Gained ($Total_{ALT}$).		

$$HighestTurn = MDA_{ALT} + (2R \cdot \pi \cdot \frac{Turn_{Magnitude}}{360} \cdot CG)$$

Where:

MDA_{ALT} = Procedure MDA
R = No-wind turn radius (NM), Formula 5-2b
$Turn_{Magnitude}$ = Turn start to rollout (deg)
CG = Standard 400 ft/NM

$MDA_{ALT}+(2*R*\pi*Turn_{Magnitude}/360*CG)$

Calculator

MDA_{ALT}		Click here to calculate
R		
$Turn_{Magnitude}$	°	
CG		
$Total_{ALT}$		

Step 3: Find the omni-directional wind component (V_{KTW}) for the highest altitude in the turn applying chapter 2, paragraph 5.

Step 4: Apply this common wind value (**Step 3**) to all first-turn wind spirals.

Note: Apply 30 knots for turn altitudes ≤ 2,000 ft above heliport/airport elevation.

Step 5: Calculate the wind spiral radius increase (ΔR) (relative R), for a given turn magnitude (ϕ) using chapter 5, formulas 5-2c and 5-2e.

Formula 5-2e. WS (ΔR).		
$$\Delta R = \frac{V_{KTW} \cdot \phi}{3600 \cdot TR}$$ Where: V_{KTW} = Windspeed, formula 2-3b; ϕ = Degrees of turn; TR = Turn Rate, formula 5-2c		
$(V_{KTW} * \phi)/(3600 * TR)$		
Calculator		
V_{KTW}		Click here to calculate
ϕ	°	
TR		
ΔR (NM)		
ΔR (ft)		

b. Turn-At-A-Fix. The first MA turn-at-a-fix may be a fly-by or fly-over fix. Use fly-by unless a fly-over is required for obstacle avoidance or where mandated by specific operational requirements. The turn fix early-turn-point must be at or beyond section 1 end.

(1) Early/Late Turn Points.

(a) The fly-by fix early-turn-point is located at (FIX-ATT-DTA) prior to the fix.

(b) The fly-by fix late-turn-point is located at a distance (FIX + ATT – DTA + rr) from the fix.

Fly-by fixes (see chapter 5, figure 5-16).

$$Early_{TP} = Fix - ATT - DTA$$

$$Late_{TP} = Fix + ATT - DTA + rr$$

(c) The fly-over early-turn-point is located at a distance (FIX - ATT) prior to the fix.

(d) The fly-over late-turn-point is located at a distance (FIX + ATT + rr) beyond the fix.

Fly-over fixes (see chapter 5, figure 5-16).

$$Early_{TP} = Fix - ATT$$

$$Late_{TP} = Fix + ATT + rr$$

(2) Turn-at-a-fix. (First MA turn) Construction. The recommended maximum turn is 70 degrees; the absolute maximum is 90 degrees. The first turn fix must be located on the final approach track extended.

Step 1: Calculate aircraft altitude at AB using chapter 5, formula 5-1c.

Step 2: Calculate fix distance based on minimum fix altitude. Where the first fix must be located at the point the helicopter reaches or exceeds a specific altitude, apply chapter 5, formula 5-2f (using the assigned/applied CG), to calculate fix distance (D_{fix}) (NM) from SOC (AB/JK) (see chapter 5, figures 5-17 through 5-20).

Formula 5-2f. Fix Distance (D_{fix}).

$$D_{fix} = \ln\left(\frac{Alt_{fix} + r}{Copter_{SOC} + r}\right) \cdot \frac{r}{CG}$$

Where:

Alt_{fix} = Minimum altitude required at fix
$Copter_{SOC}$ = Copter AB (SOC) altitude
CG = Climb Gradient (Standard 400 ft/NM)

ln((Altfix+r)/(Copter$_{soc}$+r))*r/CG

Calculator

Alt_{fix}		Click here to calculate
$Copter_{SOC}$		
CG		
D_{fix} (NM)		

Step 3: Calculate the altitude a helicopter climbing at the assigned CG would achieve over an established fix using chapter 5, formula 5-2g.

Formula 5-2g Altitude Achieved at Fix (Alt_{fix}).

$$Alt_{fix} = (r + Copter_{SOC}) \cdot e^{\left(\frac{CG \cdot D_{fix}}{r}\right)} - r$$

Where:

$Copter_{SOC}$ = Copter AB (SOC) altitude
CG = Climb Gradient (Standard 400 ft/NM)
D_{fix} = Distance (NM) from AB to fix

(r+Copter$_{SOC}$)*e^(CG*D$_{fix}$/r)-r

Calculator

$Copter_{SOC}$		Click here to calculate
CG		
D_{fix} (NM)		
Alt_{fix}		

(3) Fly-By Turn Calculations and Construction. Consider direction-of-flight-distance positive, opposite-flight-direction distance negative.

(a) Fly-By Turn Calculations.

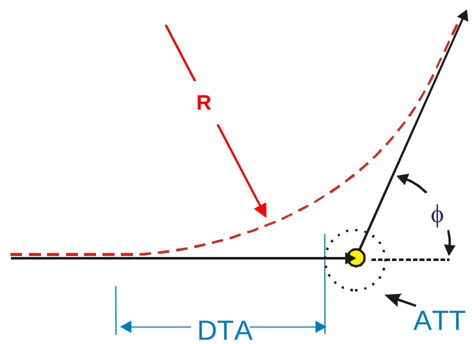
Step 1: Apply chapter 5, formula 5-2h for distance turn anticipation (DTA).

Formula 5-2h. Distance Turn Anticipation.

$$DTA = R \cdot \tan\left(\frac{\phi}{2} \cdot \frac{\pi}{180}\right)$$

Where:

ϕ = Turn/Heading Change (Degrees)
R = No-Wind Turn Radius, formula 5-2b



R*tan(ϕ/2*π/180)

Calculator

R		Click here to calculate
ϕ (Degrees)	°	
DTA (NM)		

Calculate the fix to early-turn distance ($D_{early\ TP}$) using chapter 5, formula 5-2i.

Formula 5-2i. Early Turn Distance ($D_{earlyTP}$).

$$D_{earlyTP} = ATT + DTA$$

Where:

ATT = along-track tolerance (NM)
DTA = Turn anticipation distance (NM), formula 5-2h

ATT+DTA

Calculator

ATT		Click here to calculate
DTA		
$D_{earlyTP}$ (NM)		

(b) Early Turn Point (ETP) and Area construction.

Table 5-1. Inside Turn Expansion Guide.	
Outbound Segment Boundary Relative ETP Connections	**Expansion Line Required**
Secondary & Primary **PRIOR** ETP	15-Degree Line
Secondary **Prior** ETP	15-Degree Line
Primary **Beyond** ETP	$\phi/2$
Secondary & Primary **Beyond** ETP	$\phi/2$

Note: ETP = LL' early turn point connection, 15-degree line relative the outbound segment, $\phi/2$ = half turn-angle

(c) Inside turn (Fly-By) Construction is predicated on the location of LL' and primary/secondary boundary intersections (early turn connections), relative the outbound segment, see chapter 5, table 5-1. (See chapter 5, figures 5-17 and 5-18).

Where no inside turn secondary area exists in section 1, apply secondary areas only after the turn expansion line/s intersect the outbound segment boundaries.

Apply the same technique to primary and secondary area connections when both inbound segment connection points fall either outside the outbound segment, or inside the outbound segment primary area. When both inbound connection points are within the outbound segment secondary area or its extension, table 5-1 provides a connection method for each point.

Note: Where half-turn-angle construction is indicated, apply a line splaying at the larger of, half-turn-angle, or 15 degrees, relative the outbound track. Where a small angle turn exists and standard construction is suitable for one, but not both splays; connect the uncommon splay, normally primary, to the outbound primary boundary at the same along-track distance as the secondary connection. Maintain or increase primary area as required.

Step 1: Construct a baseline (LL') perpendicular to the inbound track at distance $D_{earlyTP}$ (chapter 5, formula 5-2h) prior to the fix (see chapter 5, figures 5-17 and 5-18).

CASE 1: The outbound segment boundary, or its extension, is beyond the baseline (early-turn connection points are prior to the outbound segment boundary),

Step 1: Construct the inside turn expansion area with a line, drawn at one-half the turn angle from the inbound segment primary early turn connection point, to intercept the outbound segment primary boundary (see chapter 5, figure 5-18).

Step 2 (if required): Construct the inside turn expansion area with a line, drawn at one-half the turn angle, from the inbound segment secondary early turn connection point, to intercept the outbound segment secondary boundary (see chapter 5, figure 5-18).

CASE 2: The outbound segment secondary boundary or its extension is prior to the LL' baseline and outbound segment primary boundary or its extension is beyond the LL' baseline, (early-turn connection points are both **within** the outbound segment secondary area or its extension).

Step 1: Construct the inside-turn expansion area with a line splaying at 15-degree, (relative the outbound track) from the inbound segment secondary early turn connection point to intersect the outbound segment boundary.

Step 1Alt: Where the turn angle exceeds 75 degrees, begin the splay from L'.

Step 2: Construct the primary boundary with a line, drawn at one-half the turn angle, from the inbound segment primary early turn connection point to intercept the outbound segment primary boundary (see chapter 5, figure 5-17).

CASE 3: The outbound segment secondary and primary boundaries, or their extensions, are **prior** to the LL' baseline (primary early-turn connection point, or **both** connection points are **inside** the outbound segment primary area).

Step 1: Construct the inside turn expansion area with a line, splaying at 15-degree (relative the outbound track) from the more conservative point, (L') or (the intersection of LL' and the inbound segment inner primary boundary), to intersect the outbound segment boundaries.

Step 1Alt: Where the turn angle exceeds 75 degrees, begin the splay from L'.
In this case, terminate the inside turn secondary area at the outbound segment primary boundary, since it falls before the early turn points, LL' (see chapter 5, figure 5-18a).

(d) Outside Turn (Fly-By) Construction.

Step 1: Construct the outer primary boundary using a radius of 1/2 primary width (1.5 NM), centered on the plotted fix position, drawn from the inbound segment extended primary boundary until tangent to the outbound segment primary boundary. See chapter 5, figure 5-17.

Step 2: Construct the secondary boundary using a radius of one-half segment width (2 NM), centered on the plotted fix position, drawn from the inbound segment extended outer boundary until tangent to the outbound segment outer boundary (see chapter 5, figures 5-17, 5-18, and 5-18a). Where no inbound secondary exists, use an arc of radius one-half segment width from tangent to the outbound segment secondary boundary to terminate at the inbound segment boundary.

(3) Fly-Over Turn Construction.

(a) Inside Turn (Fly-Over) Construction.

Step 1: Construct the early-turn baseline (LL') at distance ATT prior to the fix, perpendicular to the inbound nominal track.

Step 2: Refer to chapter 5, paragraph 3b(3)(c), (skip **Step 1**).

(b) Outside Turn (Fly-Over) Construction.

Step 1: Construct the late-turn baseline (PP') at distance (ATT + rr) beyond the fix, perpendicular to the inbound nominal track. Calculate late turn distance using chapter 5, formula 5-2j (see chapter 5, figure 5-19).

Formula 5-2j. Late Turn Point Distance (D_{lateTP}).

$$D_{lateTP} = ATT + \left(rr \cdot \frac{0.3048}{1852}\right)$$

Where:

ATT = along-track tolerance (NM)

rr = delay/roll-in formula 2-4a

ATT+(rr*0.3048/1852)

Calculator		
ATT (NM)		Click here to calculate
rr (ft)		
D_{lateTP} (NM)		

Step 2: Apply wind spiral outer boundary construction for the first MA fly-over turn. See chapter 5, paragraph 3a(2)(b) for necessary data, using the higher of chapter 5, formula 5-2g output, or the assigned fix crossing altitude for TAS and turn radius calculations and chapter 5, paragraph 5 for wind spiral construction. A non-turn side secondary area may extend into the WS1 area.

(c) Obstacle Evaluations. See chapter 5, paragraph 3b(4)

(4) Section 2 Obstacle Evaluations.

(a) Turn at an Altitude Section 2. Apply the standard MA OCS slope, (or the assigned CG slope) to section 2 obstacles based on the shortest primary area distance (do) from the TIA boundary to the obstacle. Shortest primary area distance is the length of the shortest line kept within primary segments that passes through the early turn baseline of all preceding segments.

Step 1: Measure and apply the OCS along the shortest primary area distance (do) from the TIA boundary to the obstacle (single and multiple segments). See various obstacle measurement examples in chapter 5, figures 5-19 through 5-22.

Step 2: For obstacles located in secondary areas, measure and apply the OCS along the shortest primary area distance (do) from the TIA boundary to the primary boundary abeam the obstacle, then the 4:1 slope along the shortest distance to the obstacle, (taken perpendicular to the nominal track or in expansion areas, to the primary arc, the primary corner-cutter, corner apex, or other appropriate primary boundary). Where an obstacle requires multiple measurements (an obstacle is equidistant from multiple primary boundary points, or lies along perpendiculars from multiple primary boundary points, etc.), apply the more adverse result from each of the combined primary/secondary measurements. See chapter 5, figures 5-19 through 5-22.

(b) Turn at Fix Section 2. Apply an inclined OCS (MA OCS) slope, beginning at SOC at the inbound-segment end OCS height.

Step 1: Measure and apply the OCS along the shortest distance (do) from AB (parallel to track) to LL', the shortest primary distance to the obstacle (single and multiple segments). See chapter 5, figures 5-19 and 5-20, for various obstacle measurement examples.

Step 2: For obstacles located in secondary areas, measure and apply the OCS along the shortest primary area distance (do) from the TIA boundary to the primary boundary abeam the obstacle, then the 4:1 slope along the shortest distance to the obstacle, (taken perpendicular to the nominal track or in expansion areas, to the primary arc, the primary corner-cutter, corner apex, or other appropriate primary boundary). Where an obstacle requires multiple measurements (where an obstacle is equidistant from multiple primary boundary points, or lies along perpendiculars from multiple primary boundary points, etc.), apply the more adverse result from each of the combined primary/secondary measurements (see chapter 5, figure 5-21).

4. Turning Missed Approach (Second Turn).

a. DF/TF Turn (Second Turn, following turn-at-altitude). Turns at the DF path terminator fix will be fly-by or fly-over to a TF leg. In either case, the outer boundary provides fly-over protection, and the inner boundary provides fly-by protection. Maximum turn angle is 90 degrees (applicable to both tracks within the DF segment). This application provides that construction under chapter 2, or this chapter will apply, including cases where the inside and outside turn construction differs.

(1) DF/TF (Fly-By) Turn.

(a) Inside DF/TF (Fly-By) construction.

CASE 1: Full width inside secondary exists at the early turn point (LL').

Step 1: Construct a baseline (LL') perpendicular to the inbound track nearer the turn side boundary at distance $D_{earlyTP}$ (chapter 5, formula 5-2h) prior to the fix.

Step 2: Apply chapter 2 criteria.

CASE 2: Less than full width inside secondary exists at (LL').

Step 1: Apply chapter 5, paragraph 3b(3)(c) criteria.

(b) Outside DF/TF (Fly-By) construction.

CASE 1: Full width outside secondary exists at the early turn point (L'L'').

Step 1: Construct a baseline (L'L'') perpendicular to the inbound track nearer the non-turn side boundary at distance $D_{earlyTP}$ (chapter 5, formula 5-2h) prior to the fix.

Step 2: Apply chapter 2 criteria. See chapter 5, figures 5-21 through 5-22.

CASE 2: Less than full width outside secondary exists at (L'L'').

Step 1: Apply chapter 5, paragraph 3b(3)(d) criteria.

(2) DF/TF (Fly-Over) Turn.

(a) Inside DF/TF (Fly-Over) Turn Construction.

Step 1: Construct a baseline (LL') perpendicular to the inbound track nearer the turn side boundary at distance ATT prior to the fix (see chapter 5, figure 5-22).

Note: Where half-turn-angle construction is specified, apply a line splaying at the larger of half-turn-angle or 15 degrees relative the outbound track.

CASE 1: No inside secondary area exists at LL'.

Step 1: Create the OEA early-turn protection by constructing a line, splaying at the larger of one-half (1/2) the turn angle, or 15 degrees relative the outbound track, from the intersection of LL' and the inbound segment inner primary boundary to connect with the outbound TF segment boundaries.

The TF secondary area begins at the intersection of this diagonal line and the outbound segment boundary.

CASE 2: Partial width inside secondary area exists at LL'.

Step 1: Create the OEA early-turn primary area protection by constructing a line, splaying at the larger of one-half (1/2) the turn angle, or 15 degrees relative the outbound track, from the intersection of LL' and the inbound segment inner primary boundary to connect with the TF segment primary boundary.

Step 2: Create the OEA early-turn secondary protection by constructing a line, splaying at the larger of one-half (1/2) the turn angle, or 15 degrees relative the outbound track, from the intersection of LL’ and the inbound segment inner boundary to connect with the TF segment boundary.

CASE 3: Full width inside secondary area exists at LL’.

Step 1: Apply chapter 2 criteria. See chapter 5, figure 5-21.

(b) Outside DF/TF (Fly-Over) Turn Construction.

Step 1: Construct the late-turn baseline for each inbound track, (PP’) for the track nearer the inside turn boundary, and (P’P’’) for the outer track at distance (ATT + rr) beyond the fix, perpendicular to the appropriate inbound track. See chapter 5, figure 5-22.

Note: A DF/TF Fly-Over turn is limited to 90 degrees (both inbound tracks) and should require no more than one WS per baseline. Construct the outside track WS (WS1) on base line **P’P’’**, then construct WS2 on baseline **PP’.**

Step 2: Apply wind spiral construction, see chapter 5, paragraph 3a(2)(b) for necessary data, and chapter 5, paragraph 5 for wind spiral construction See chapter 5, figure 5-22.

b. TF/TF Turn (Second Turn, following turn-at-fix). Turns at the TF path terminator fix will be fly-by or fly-over to a TF leg. In either case, the outer boundary provides fly-over protection, and the inner boundary provides fly-by protection. Maximum turn angle is 90 degrees. This application provides that construction under chapter 2, or this chapter will apply, including cases where the inside and outside turn construction differs.

(1) TF/TF (Fly-By) Turn.

(a) Inside TF/TF (Fly-By) construction.

Step 1: Apply chapter 2 criteria.

(b) Outside TF/TF (Fly-By) construction.

Step 1: Apply chapter 2 criteria.

(2) TF/TF (Fly-Over) Turn.

(a) Inside TF/TF (Fly-Over) Turn Construction.

Step 1: Apply chapter 2 criteria.

(b) Outside TF/TF (Fly-Over) Turn Construction.

Step 1: Apply chapter 2 criteria.

5. Wind Spiral Cases. Wind Spiral (WS) construction applies to turn-at-an-altitude, turn-at-a-fix (Fly-Over) for the first MA turn, and DF/TF (Fly-Over) for the second turn. The late-turn line P' designator is typically placed where the baselines cross. Where baseline extension is required, mark each baseline inner end with P'. Additional WS examples are available in Order 8260.54.

Each WS has several connection options along its boundary. The chosen connection(s) must provide the more conservative reasonable track and protection areas (see chapter 5, figures 5-23 through 5-25 for examples).

- A 15-degree, (or greater*) splay line to join outbound segment outer boundaries, from:
  - WS/direct-to-fix tangent point
  - WS to WS tangent line origin
  - WS to WS tangent line end
  - WS/outbound segment parallel point (DF segment NA)

- A tangent line to join the next WS (see chapter 5, figure 5-25)
- A tangent line direct to the next fix (DF segment) (see chapter 5, figure 5-24)
- A tangent line, converging at 30 degrees to the segment track (TF segment) (see chapter 5, figure 5-20)

***Note:** See chapter 5, paragraphs 5b(1) and 5b(2) for alternate connection details.

Note: Where multiple WSs exist, a line from the earlier WS splaying at 15 degrees relative the tangent line between WSs may produce the more conservative construction.

Outbound segment type and turn magnitude are primary factors in WS application. Refer to chapter 5, table 5-2 for basic application differences. Calculate rr using chapter 2, formula 2-4a.

Table 5-2. MA First Turn Wind Spiral Application Comparison.

	Turn At Fix (FO)	Turn At Altitude
WS1 Baseline (PP')	Fix + ATT + rr	TIA + rr
WS2 Baseline (PP')	Fix + ATT + rr	TIA + rr
WS3 Baseline (CD Ext)	NA	TIA + rr
WS Number	1 or 2	1, 2, or 3 *
Final WS Connection (Tangent line)	30° to outbound track	Direct to Fix

* Where a required turn exceeds that served by three wind spirals, consider adding fixes to avoid prohibitively large protection areas resulting from further wind spiral application.

a. Turn-at-Fix (FO) and Turn-at-Altitude WS Comparison. Three cases for outer-boundary wind spirals commonly exist:

- (Case 1), Small angle turns use one wind spiral (WS1);
- (Case 2), Turns near/exceeding 90° ~ use a second wind spiral (WS2); and
- (Case 3), turns near/exceeding 180° ~ use a third wind spiral (WS3).

(1) Turn-at-Altitude WS application concludes with a line tangent to the final WS direct to the next fix.

(2) Turn-at-Fix (FO) WS application concludes with a line tangent to the final WS converging at a 30-degree angle to the outbound segment nominal track. The intersection of this line with the nominal track establishes the earliest maneuvering point for the next fix. The minimum segment length is the greater of:

- The minimum length calculated using the chapter 2 formulas or,
- The distance from previous fix to the intersection of the 30-degree converging outer boundary line extension and the nominal track, (plus DTA). See chapter 5, paragraph 4a.

(3) Second MA Turn DF/TF Turn-at-Fix (FO) WS application concludes with a line tangent to the final WS converging at a 30-degree angle to the outbound segment nominal track. This construction requires two WS baselines, one for each inbound track. Each late turn baseline is located (ATT + rr) beyond the fix, oriented perpendicular to the specific track. The baseline for the inbound track nearer the inside turn boundary is designated <u>PP’</u>, the baseline associated with the outside turn track is designated <u>P’P’’</u>. For convenience P’ is often placed at the intersection of the two baselines, but a copy properly goes with each baseline inner end if baseline extensions are required (see chapter 5, figure 5-22).

b. First MA Turn WS Construction. Find late turn point distance ($D_{late\ TP}$) using chapter 5, formula 5-2j.

(1) <u>CASE 1:</u> Small angle turn using 1 WS.

Step 1: Construct the WS1 baseline, (<u>PP’</u>) perpendicular to the straight MA track at the late-turn-point (see chapter 5, table 5-2 for line PP’ location). See chapter 5, figures 5-5 and 5-8.

Step 2: Locate the wind spiral center on <u>PP’</u> at distance R (no-wind turn radius, using chapter 5, formula 5-2b; see chapter 5, figure 5-8) from the intersection of <u>PP’</u> and the inbound-segment outer-boundary extension (see chapter 5, figures 5-8 and 5-9).

Step 3: Construct WS1 from this outer boundary point in the direction of turn until tangent to the WS/Segment connecting line from chapter 5, table 5-2 (see chapter 5, figure 5-9).

CASE 1-1: Turn-at-Altitude (WS1 ends when tangent to a line direct to fix).

Step 1: Construct the OEA outer primary and secondary boundary lines parallel to this track (0.5-1.5-1.5-.0.5 segment width). See chapter 5, figure 5-9.

Step 2: Construct a line from the WS1 tangent point, splaying at 15 degrees from the WS1-to-fix track until it intersects the parallel boundary lines or reaches the segment end (see chapter 5, figure 5-9).

Note: Consider ‘full-width protection at the fix’ to exist where the splay line is tangent to a full-width- radius- circle about the fix.

Step 2Alt: Where **Step 2** construction provides less than full-width protection at the DF fix, construct the OEA outer boundary with a line splaying from the WS1/direct-to-fix tangent point at 15 degrees relative the direct-to-fix line, (or greater where required to provide full-width protection at the DF fix), until it intersects the parallel boundary lines (not later than tangent/tangent-extension to the full width-arc about the fix), and provides full-width protection at or before the DF fix. DF secondary areas begin/exist only where full width primary exists (see chapter 5, figure 5-9).

Note: Where excessive splay (dependent upon various conditions generally in the 35-40 degree range), consider lengthening the segment, restricting the speed, category, etc. to avoid protection and/or construction difficulties.

CASE 1-2: Turn-at-Fix (FO) (WS1 ends when tangent to a 30-degree line converging to nominal track).

Step 1: Construct the OEA outer boundary line using WS1 and the tangent 30-degree converging line until it crosses the outbound segment boundaries (see chapter 5, figure 5-19).

Step 1a: Where WS1 lies within the outbound segment primary boundary, construct the OEA boundary using WS1 and a line (from the point WS1 is parallel to the outbound segment nominal track), splaying at 15 degrees relative the outbound segment nominal track until it intersects the outbound segment boundary lines.

Step 1b: Where WS1 lies within the outbound segment secondary boundary, construct the OEA boundary using WS1 and a line (from the point WS1 is parallel to the outbound segment nominal track), splaying at 15 degrees relative the outbound segment nominal track until it intersects the outbound segment boundary line. Continue WS1 and the tangent 30-degree converging line to establish the inner primary/secondary boundary (see chapter 5, similar figure 5-24).

(2) CASE 2: Larger turn using more than 1 WS. For turns nearing or greater than 90 degrees, WS2 may be necessary. See chapter 5, figure 5-20.

Step 1: To determine WS2 necessity, locate its center on baseline PP', at distance R from the inbound-segment inner-boundary extension.

Step 2: Construct WS2 from this inner boundary point in the direction of turn until tangent to the WS/WS, or WS/Segment connecting line from chapter 5, table 5-2. See chapter 5, figure 5-20.

Step 3: Where WS2 intersects, or is outside WS1 construction, (including the connecting and expansion lines where appropriate), include WS2 in the OEA construction. Otherwise revert to the single WS construction.

Step 3a: Connect WS1 and WS2 with a line tangent to both (see chapter 5, figure 5-20).

Note: The WS1/ WS2 tangent line should parallel a line between the WS center points.

<u>CASE 2-1</u>: Turn-at-Altitude (WS2 ends when tangent to a line direct to fix).

Step 1: Construct the OEA outer primary and secondary boundary lines parallel to this track (0.5-1.5-1.5.0.5 segment width).

Step 2: Construct a line from the WS2 tangent point, splaying at 15 degrees from the WS2-to-fix track until it intersects the parallel boundary lines or reaches the segment end (see chapter 5, figure 5-9).

Note: Consider 'full-width protection at the fix' exists where the splay line is tangent to a full-width- radius- circle about the fix.

Step 2Alt: Where **Step 2** construction provides less than full-width protection at the DF fix, construct the OEA outer boundary with a line splaying from the WS2/direct-to-fix tangent point at 15 degrees relative the direct-to-fix line, (or greater where required to provide full-width protection at the DF fix), until it intersects the parallel boundary lines (not later than tangent/tangent-extension to the full-width-arc about the fix), <u>and</u> provides full-width protection at or before the DF fix. Where the turn angle is ≤ 105 degrees, or the divergence angle between the WS/WS tangent line and the direct-to-fix line is ≤ 15 degrees, apply the splay line form the WS1/WS2 tangent line origin. DF secondary areas begin/exist only where full width primary exists (see chapter 5, figure 5-9).

Note: Where excessive splay exists (dependent upon various conditions but generally greater than 30 degrees), consider using an earlier splay origin point, lengthening the segment, restricting the speed, category, etc. to avoid protection or construction difficulties (see chapter 5, paragraph 5 for origin points).

<u>CASE 2-2</u>: Turn-at-Fix (FO): (WS2 ends when tangent to a 30-degree line converging to nominal track).

Step 1: Construct the OEA outer boundary line using WS2 and the 30-degree converging line until it crosses the outbound segment boundaries (see chapter 5, figure 5-20).

Step 1a: Where WS2 lies within the outbound segment primary boundary, construct the OEA boundary using WS1, WS2, and a line (from the point WS1 or WS2 is parallel to the outbound segment nominal track, the more conservative), splaying at 15 degrees relative the outbound segment nominal track until it intersects the outbound segment boundary lines.

Step 1b: Where WS2 lies within the outbound segment secondary boundary, construct the OEA boundary using WS1, WS2, and a line (from the point WS2 is parallel to the outbound segment nominal track), splaying at 15 degrees relative the outbound segment nominal track until it intersects the outbound segment boundary line. Continue WS2 and the tangent 30-degree converging line to establish the inner primary/secondary boundary.

(3) CASE 3: Larger turn using more than 2 WSs. (Not applicable to Turn-at-Fix due to 90 degree turn limit). For turns nearing or greater than 180 degrees (such as a missed approach to a holding fix at the IF),

Step 1: Construct the WS3 baseline perpendicular to the straight MA track along CD-extended toward the turn side. See chapter 5, figure 5-15.

Step 2: To determine WS3 necessity, locate its center on the WS3 baseline at distance R from point C. See chapter 5, figure 5-15.

Step 3: Construct WS3 from point C in the direction of turn until tangent to the WS/WS, or WS/Segment connecting line from chapter 5, table 5-2. See chapter 5, figure 5-15.

Step 4: Where WS3 intersects, or is outside WS2 construction, include WS3 in the OEA construction. Otherwise revert to the dual WS construction. See chapter 5, figure 5-15.

Step 5: Connect WS2 and WS3 with a line tangent to both. See chapter 5, figure 5-15.

Note: The WS2 & WS3 tangent line should parallel a line between the WS center points.

CASE 3-1: Turn-at-Altitude: (WS3 ends when tangent to a line direct to fix)

Step 1: Construct the OEA outer primary and secondary boundary lines parallel to this track (0.5-1.5-1.5-0.5 segment width). See chapter 5, figure 5-15.

Step 2: Construct a line from the WS3 tangent point, splaying at 15 degrees from the WS3-to-fix track until it intersects the parallel boundary lines or reaches the segment end. See chapter 5, figure 5-15.

(4) Outside Turn Secondary Area. Outbound segment secondary areas following wind spirals begin where either the 30-degree converging line crosses the secondary and primary boundaries from outside the segment, or the 15-degree splay line crosses the primary boundary from inside the segment.

c. Second MA Turn WS Construction (DF/TF FO). To accommodate the two inbound tracks in the DF leg, the second MA turn DF/TF (fly-over) construction uses two WS baselines, PP' and P'P''.

Note: Apply chapter 5, table 5-2 PP' location information for each baseline (formula is identical).

(1) CASE 1: Small angle turn using 1 WS for each inbound DF track.

Step 1: Construct the WS1 baseline, (P'P'') perpendicular to the DF track nearer the outside of the DF/TF turn, at the late-turn-point. See chapter 5, table 5-2 for line PP' location.

Step 1a: Construct the WS2 baseline, (PP') perpendicular to the DF track nearer the inside of the DF/TF turn, at the late-turn-point. See chapter 5, table 5-2 for line PP' location.

Step 2: Locate the WS1 center on P'P'' at distance R (no-wind turn radius, using chapter 5, formula 5-2b; see chapter 5, figure 5-5) from the intersection of P'P'' and the inbound-segment outer-boundary extension.

Step 2a: Locate the WS2 center on PP' at distance R (no-wind turn radius, using chapter 5, formula 5-2b; see chapter 5, figure 5-5) from the intersection of PP' and the inbound-segment inner-boundary extension.

Step 3: Construct WS1 from this outer boundary point in the direction of turn until tangent to the WS/Segment connecting line from chapter 5, table 5-2.

Step 3a: Construct WS2 from this inner boundary point in the direction of turn until tangent to the WS/Segment connecting line from chapter 5, table 5-2.

Step 4: Where WS2 intersects WS1 construction, include WS2 in the OEA construction, and connect WS1 to WS2 with a tangent line. Otherwise revert to the single WS construction.

CASE 1-1: WS1 and/or WS2 lie outside the outbound segment boundary.

Step 1: Construct the OEA outer boundary using WS1 and/or WS2 and the tangent 30-degree converging line until it crosses the outbound segment boundaries . See chapter 5, figure 5-22.

CASE 1-2: WS1 and WS2 lie inside the outbound segment boundary.

Step 1: Where WS1 and/or WS2 lie inside the outbound segment primary boundary, construct the OEA outer boundary using WS1 and/or WS2 and a line (from the point WS1 or WS2 is parallel to the outbound segment nominal track), splaying at 15 degrees relative the outbound segment nominal track until it intersects the outbound segment boundary lines.

Step 1a: Where WS1 and/or WS2 lie inside the outbound segment secondary boundary, construct the OEA outer boundary using WS1 and/or WS2 and a line (from the point WS1 or WS2 is parallel to the outbound segment nominal track), splaying at 15 degrees relative the outbound segment nominal track until it intersects the outbound segment boundary line. Continue the final WS and 30 degrees converging line to establish the primary/secondary boundary.

6. Missed Approach Climb Gradient. Where the MA standard OCS is penetrated and a CG is required, specify a missed approach CG to clear the penetrating obstruction. MA starting ROC is 100 ft (plus adjustments). ROC increases at 96 ft/NM, measured parallel to the MA track to TIA end (Turn-at-Altitude), or early-turn point (Turn-at-Fix), then shortest primary distance to the next fix. Apply fix-to-fix distance for subsequent segments. Where a part-time altimeter is in use, consider the helicopter SOC altitude to be the MDA associated with the local altimeter (ensures adequate CG is applied).

Step 1: Calculate the ROC, the altitude at which the ROC for the obstacle is achieved, and the required CG (ft/NM) using chapter 5, formula 5-13.

Step 2: Apply the CG to:

- The altitude which provides appropriate ROC, or
- The point/altitude where the subsequent MA OCS clears all obstacles.

Step 2a: Where a RASS adjustment is applicable for climb-to-altitude operations (prior to turn, terminate CG, etc.), apply the CG associated with the lower MDA (chapter 5, formula 5-3). Where there is a local altimeter, to establish the RASS-based climb-to-altitude, add the difference between the local altimeter-based MDA and the RASS-based MDA to the climb-to-altitude and round to the next higher 100-ft increment (see Order 8260.3, Volume 1, chapter 3 for further details).

Formula 5-3. ROC/CG/Minimum Altitude/OCS.

STEP 1

$$ROC_{obs} = ROC_{start} + 96 \cdot d$$

Where:
ROC_{start} = SOC ROC (100 ft for NVGP)
d = distance (NM) CG origin (SOC) to obstacle

ROC_{start}+96*d

STEP 2

$$Alt_{min} = O_{elev} + ROC_{obs}$$

Where:
ROC_{obs} = Step 1 result
O_{elev} = Obstacle Elevation (MSL)

O_{elev}+ROC_{obs}

STEP 3

$$CG = \frac{r}{d} \cdot \ln\left(\frac{(r + Alt_{min})}{(r + Copter_{SOC})}\right)$$

Where:
Alt_{min} = Step 2 result
$Copter_{SOC}$ = Helicopter altitude (MSL) at CG origin
d = distance (NM), CG origin (SOC) to obstacle

r/d*ln((r+ALT_{min})/(r+$Copter_{SOC}$))

Calculator

ROC_{start}		Click here to calculate
O_{elev}		
d (NM)		
$Copter_{SOC}$		
ROC_{obs}		
Alt_{min}		
CG		

Note: Figures are NOT drawn to scale.

Figure 5-1a. Missed Approach Optimum Flight Paths.

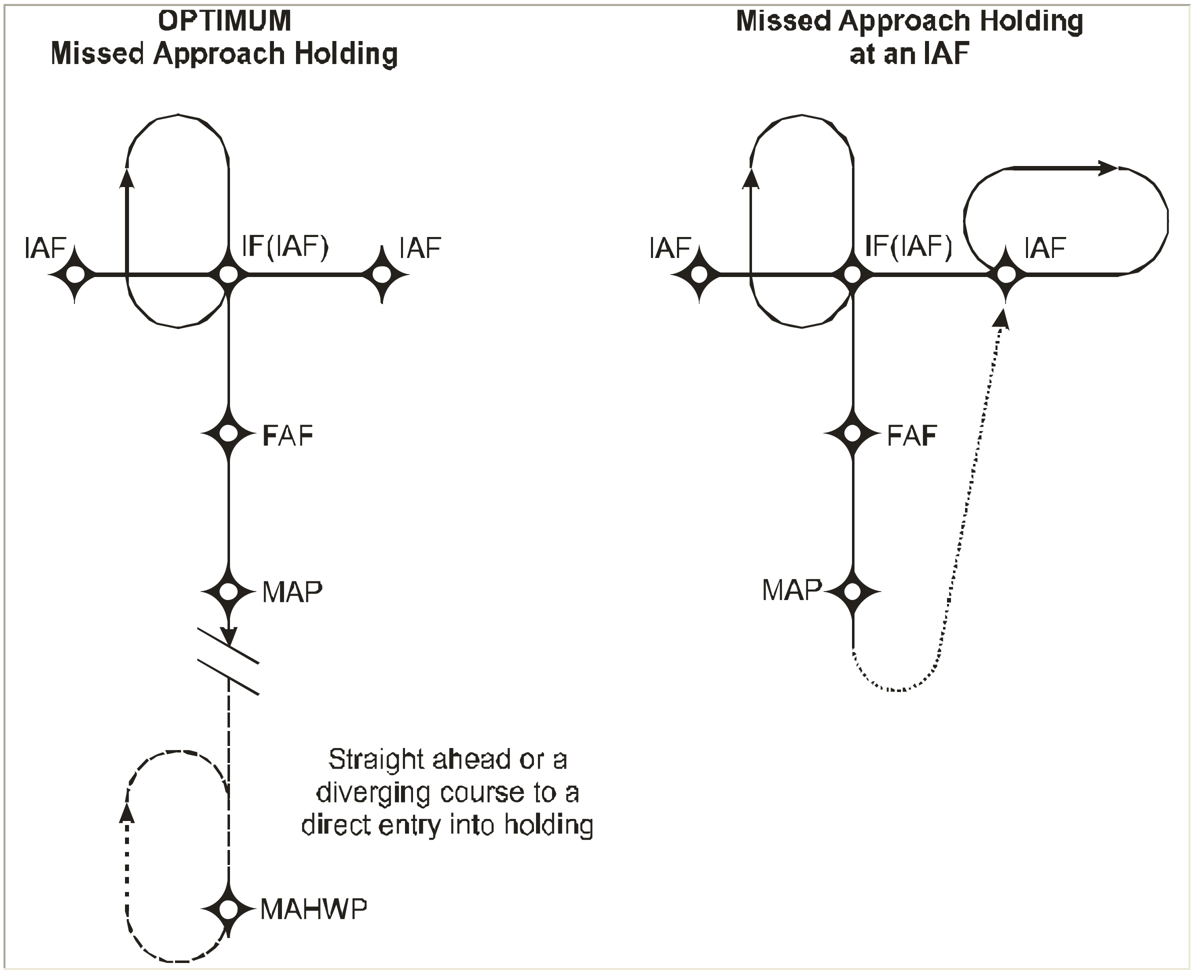


Figure 5-1b. MAS Point/Line Identification.

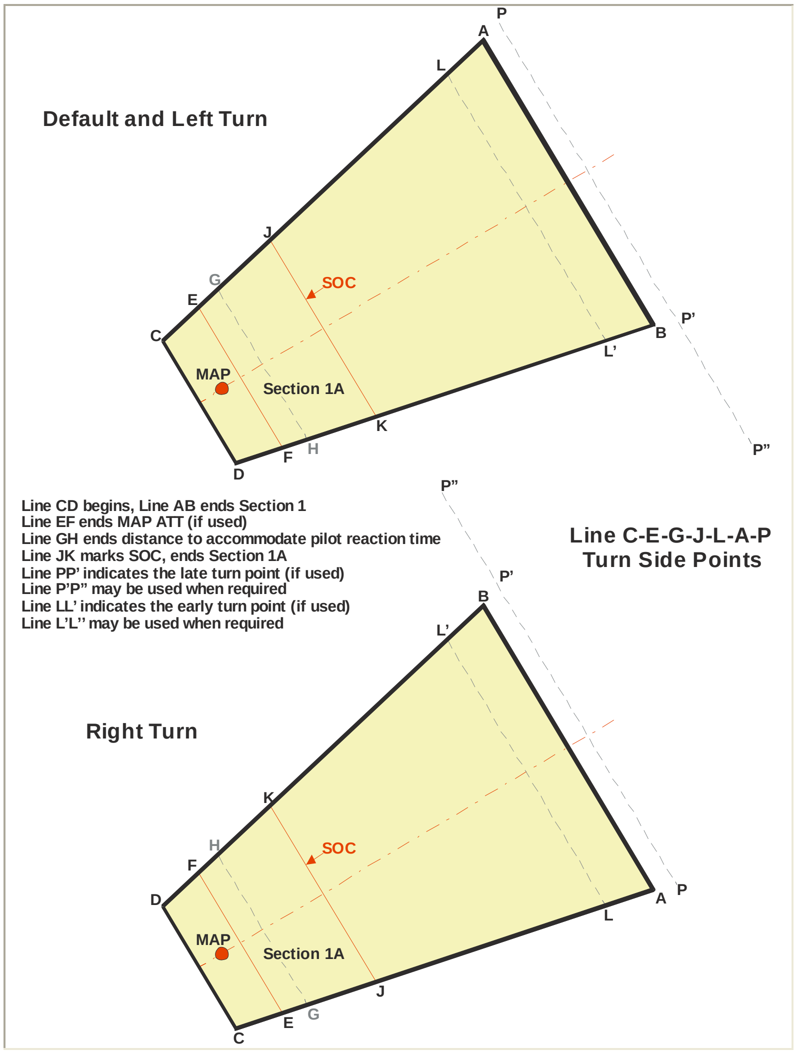


Figure 5-2. Missed Approach Section 1.

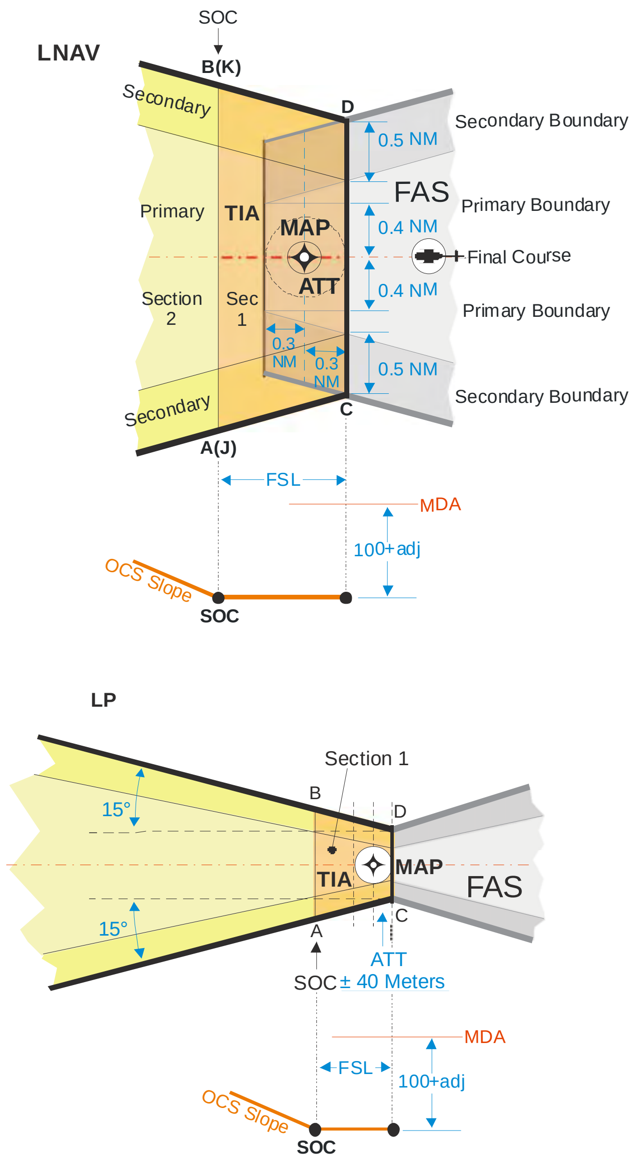


Figure 5-3. Straight Missed Approach.

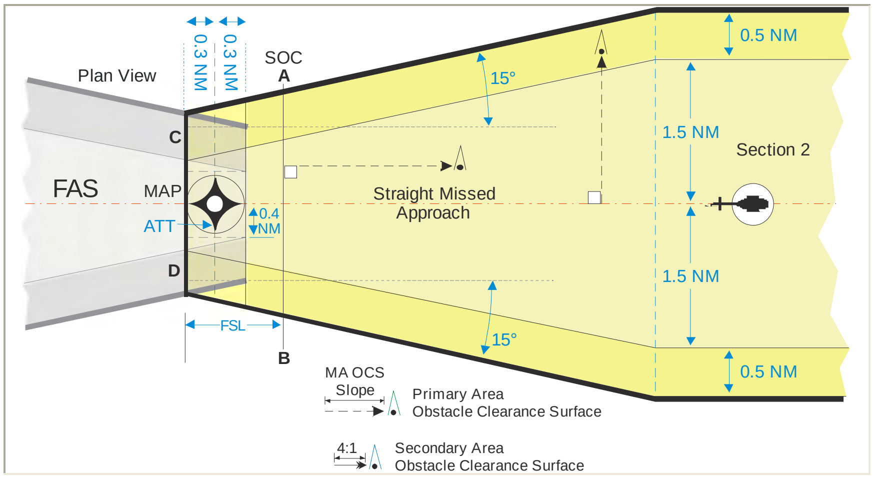


Figure 5-4. Straight Missed Approach (GPS/LNAV / LP).

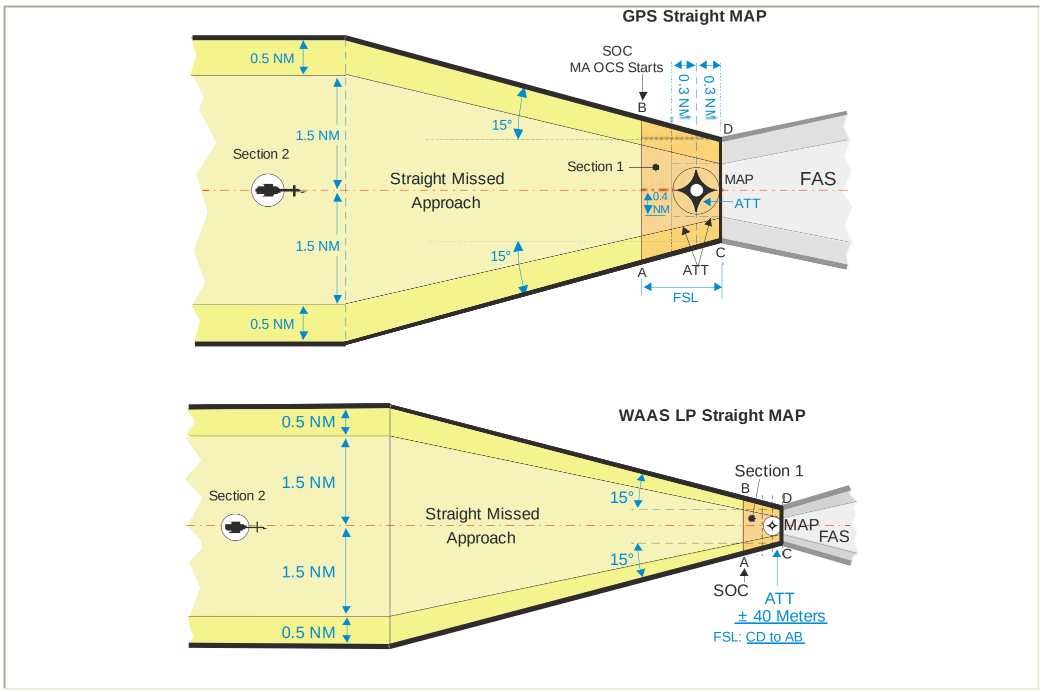


Figure 5-5. Turn at Altitude Missed Approach, ≤ 75° (Minimum Turning Altitude).

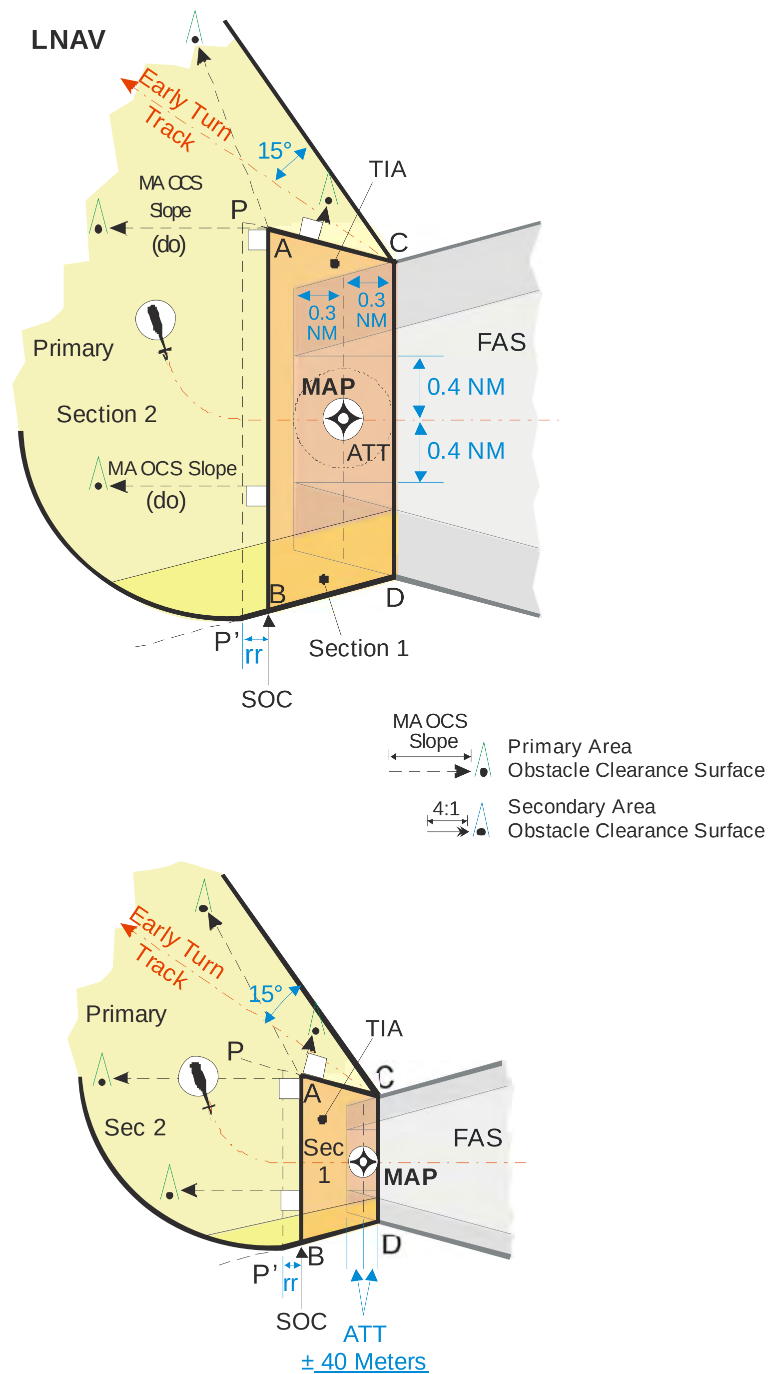


Figure 5-6. Turn at Altitude Missed Approach, ≤ 75° (> Minimum Turning Altitude).

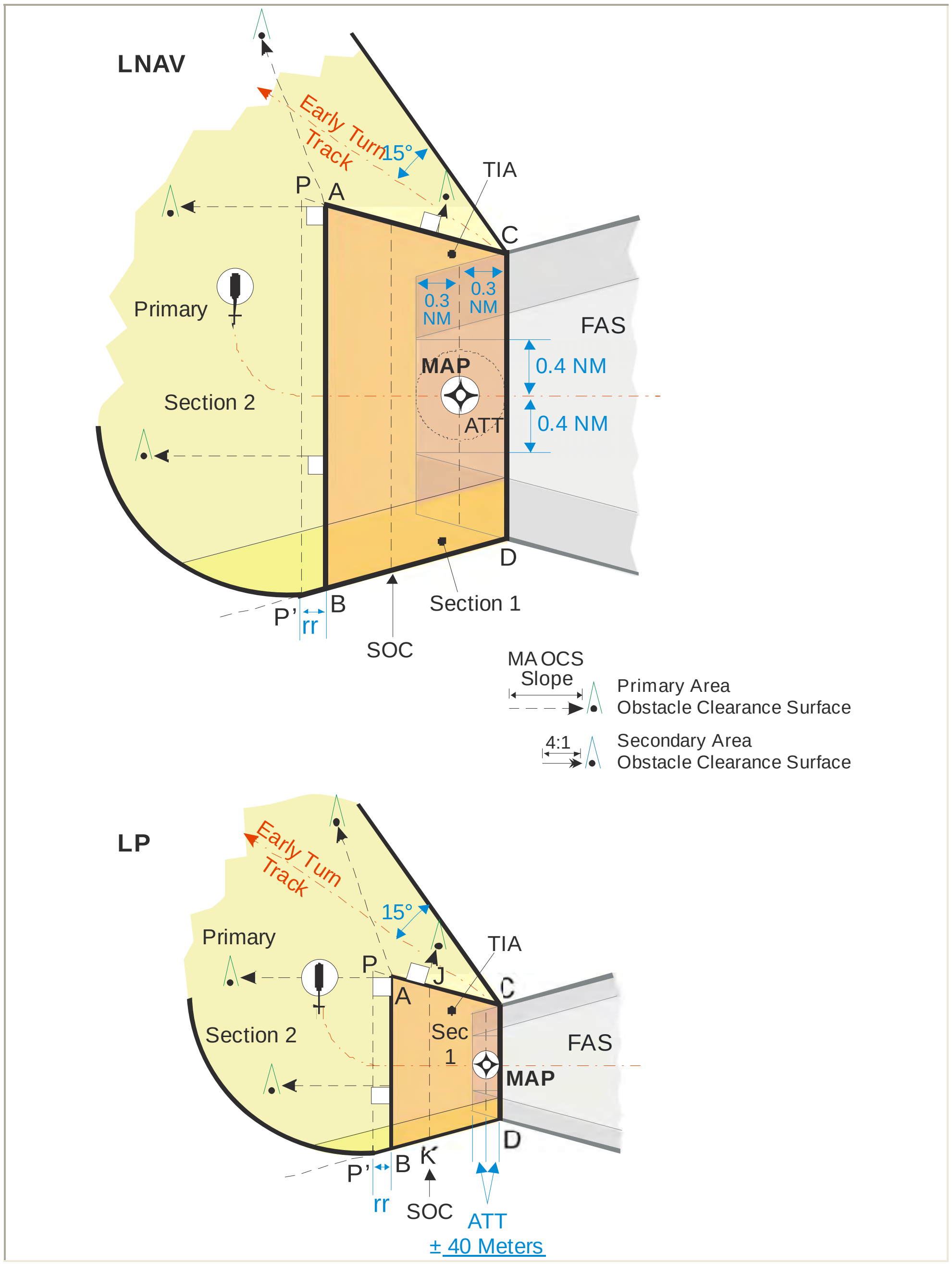


Figure 5-7. Turn at Altitude Missed Approach, > 75˚ (Minimum Turn Altitude).

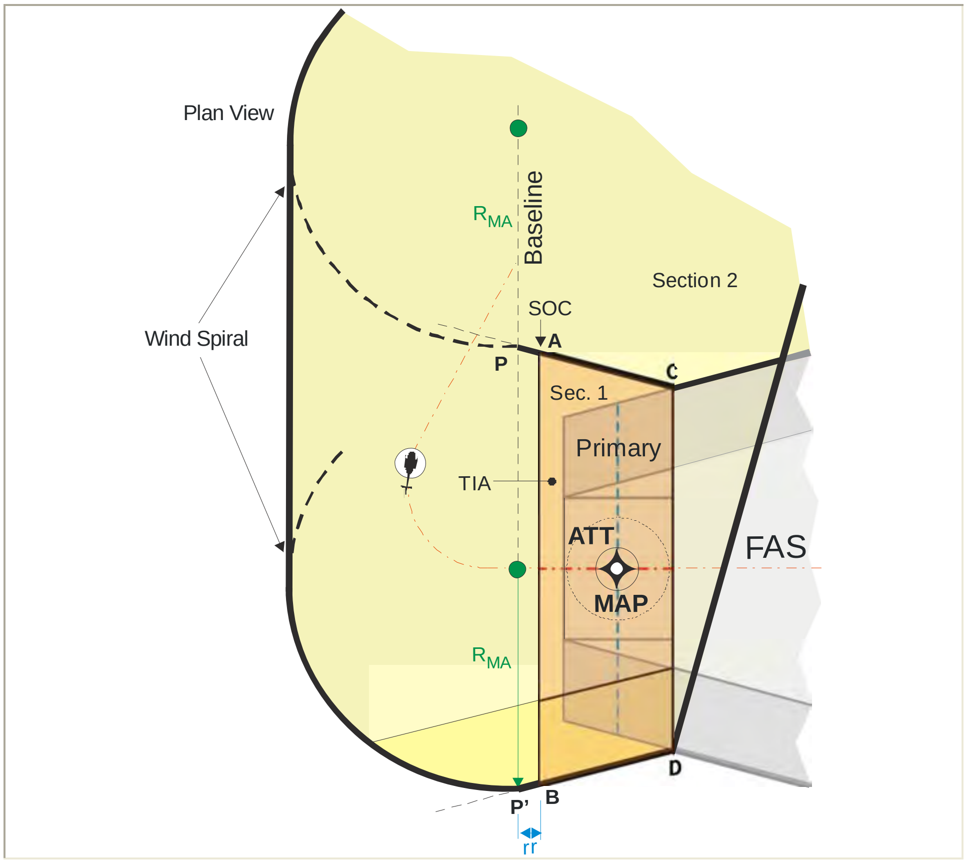


Figure 5-8. Turn at Altitude Missed Approach, ≤ 75˚ (Greater than Minimum Turn Altitude).

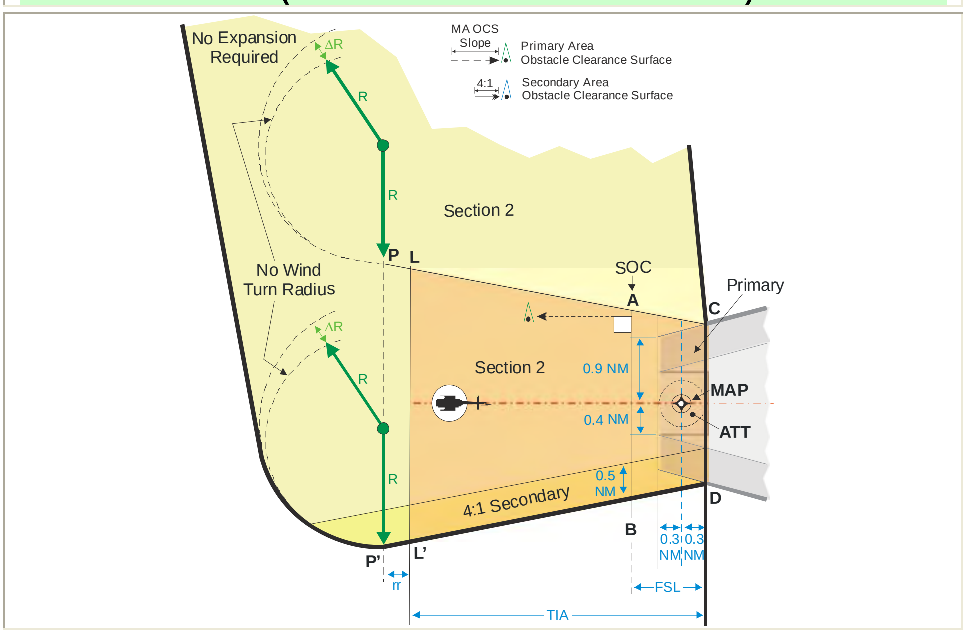


Figure 5-9. Turn at Altitude Missed Approach, ≤ 75 Degrees (Minimum Turn Altitude).

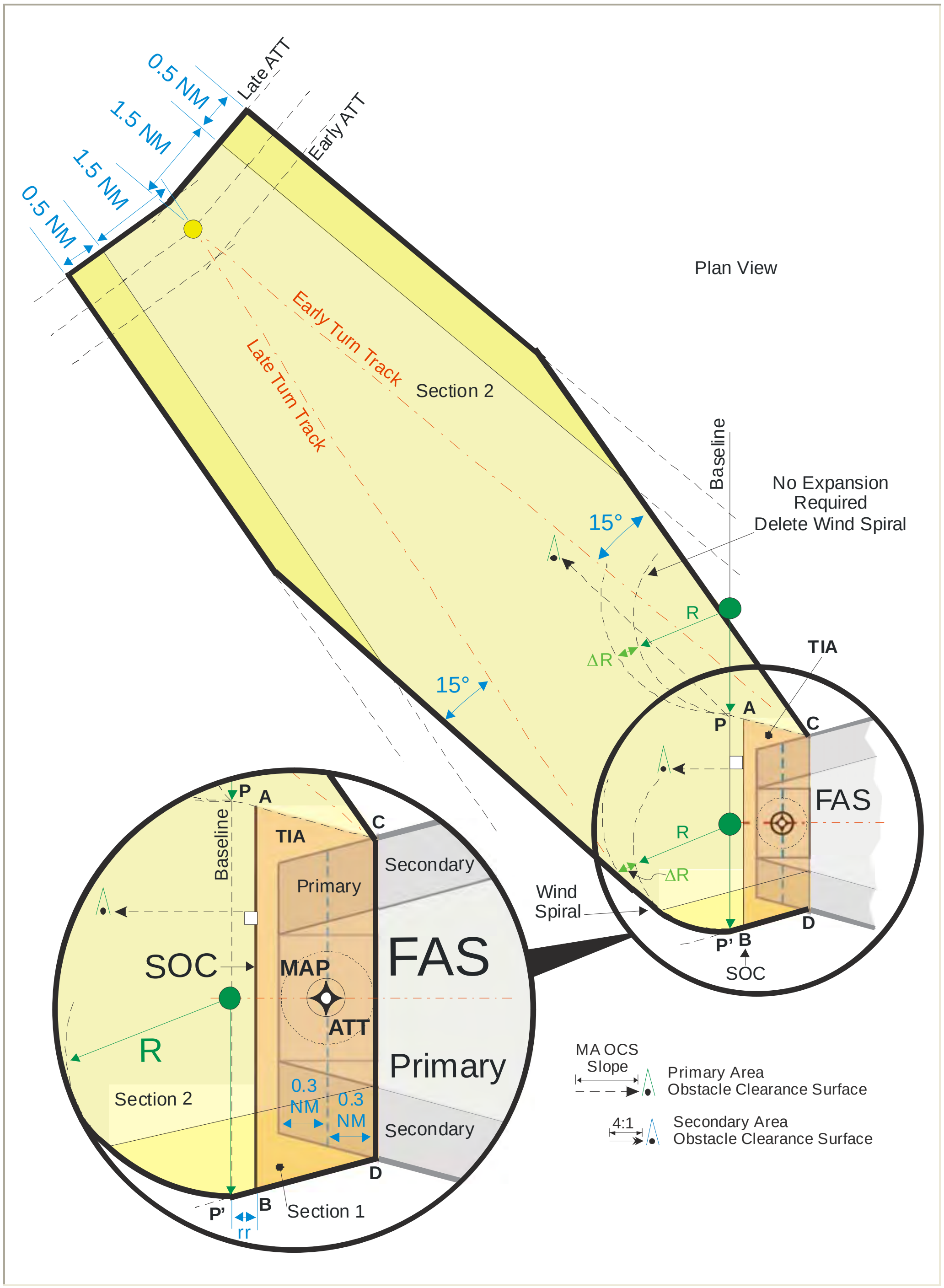


Figure 5-10. Turn at Altitude Missed Approach, >75 degrees (Minimum Turn Altitude).

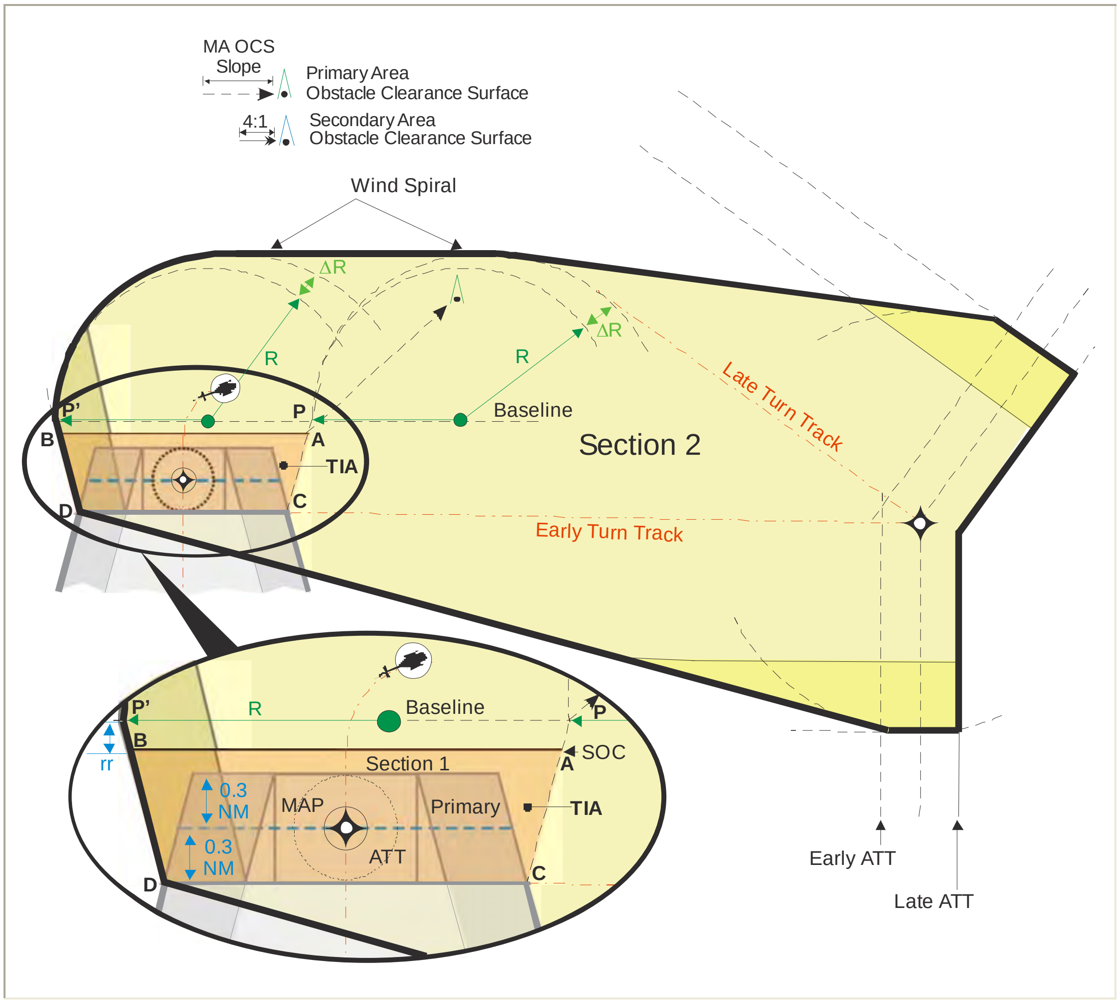
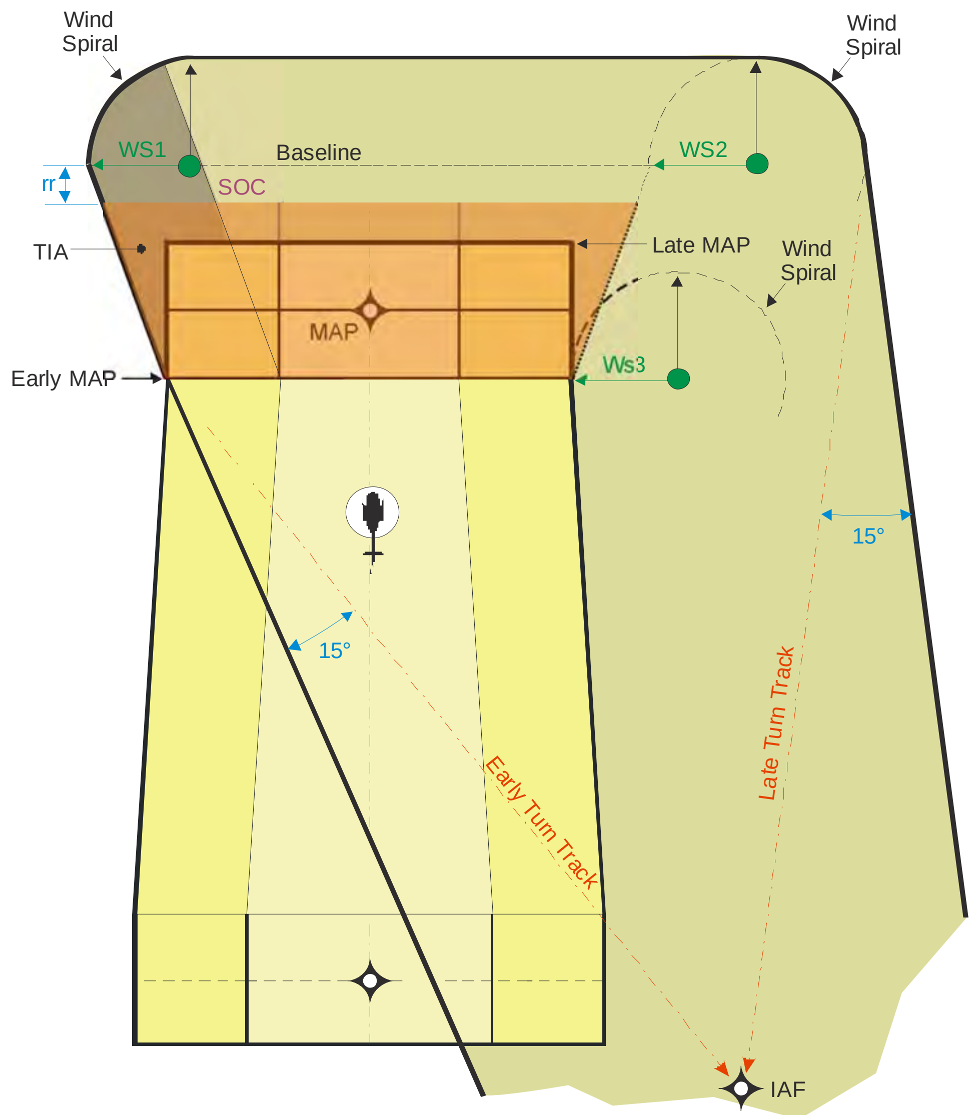


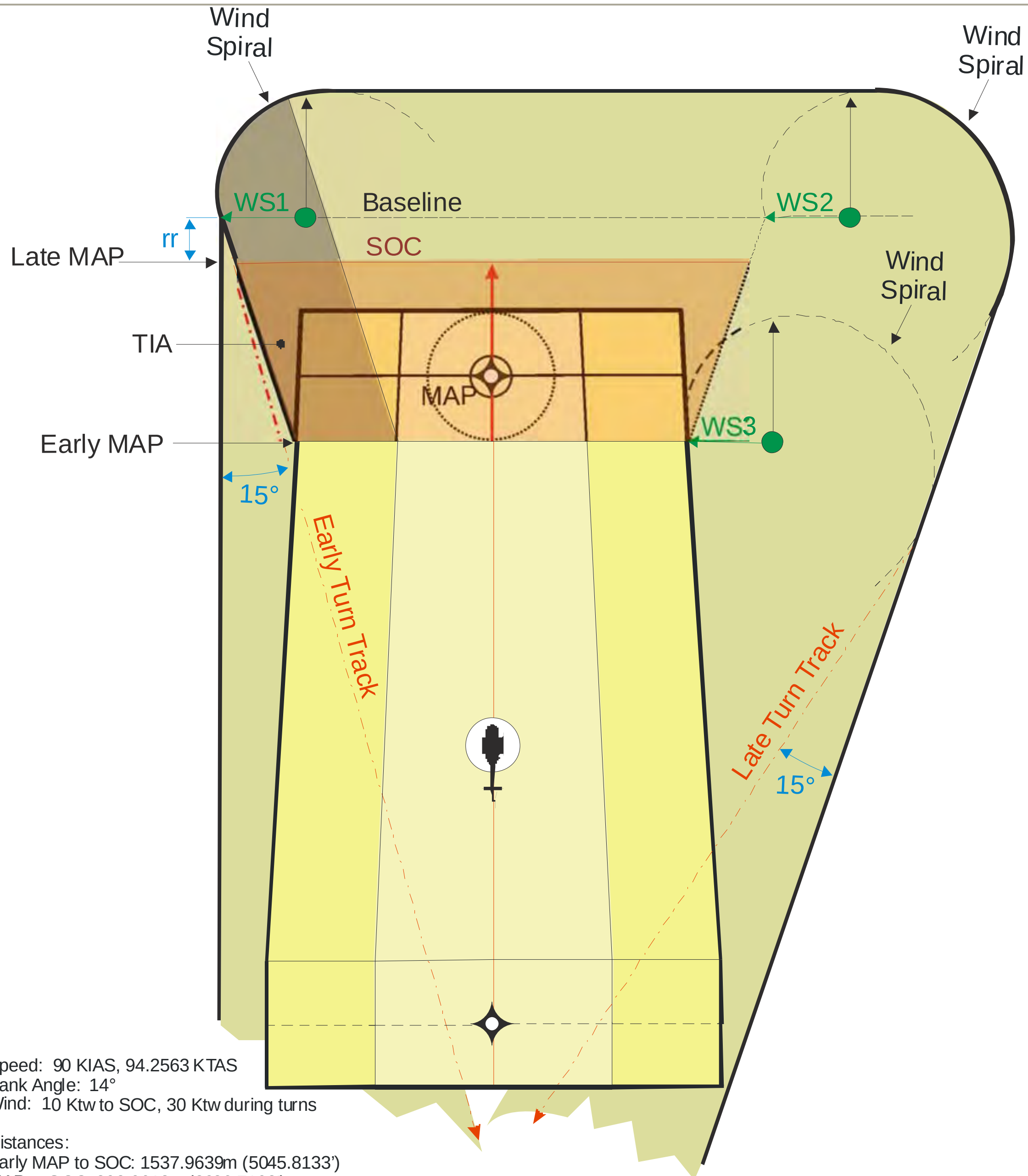
Figure 5-11. 70 KIAS Missed Approach Segment, >75 degrees, ≤ 165 degrees (Minimum Turn Altitude) 2 WS.



Speed: 70 KIAS, 73.31 KTAS
Bank Angle: 11°
Wind: 10 Ktw to SOC, 30 Ktw during turns

Distances:
Early MAP to SOC: 1452.2731m (4764.6755')
MAP to SOC: 892.0613m (2926.7103')
Late MAP to SOC: 341.0644m (1118.9777')

Figure 5-12. 90 KIAS Missed Approach Segment, > 165 degrees (Minimum Turn Altitude) 3 WS.



Speed: 90 KIAS, 94.2563 KTAS
Bank Angle: 14°
Wind: 10 Ktw to SOC, 30 Ktw during turns

Distances:
Early MAP to SOC: 1537.9639m (5045.8133')
MAP to SOC: 892.0613m (2926.7103')
Late MAP to SOC: 426.7639m (1400.1440')

Early MAP to W/S Limit (90°): 3006.3146m (9863.2369')
SOC to WS Baseline: 383.5364m (1258.3215') (rr)

No Wind Turn Radius: 959.1922m (3146.9560')

Figure 5-13. Direct to Fix Segment Following a TIA completion ≤ 75 Degrees (One WS).

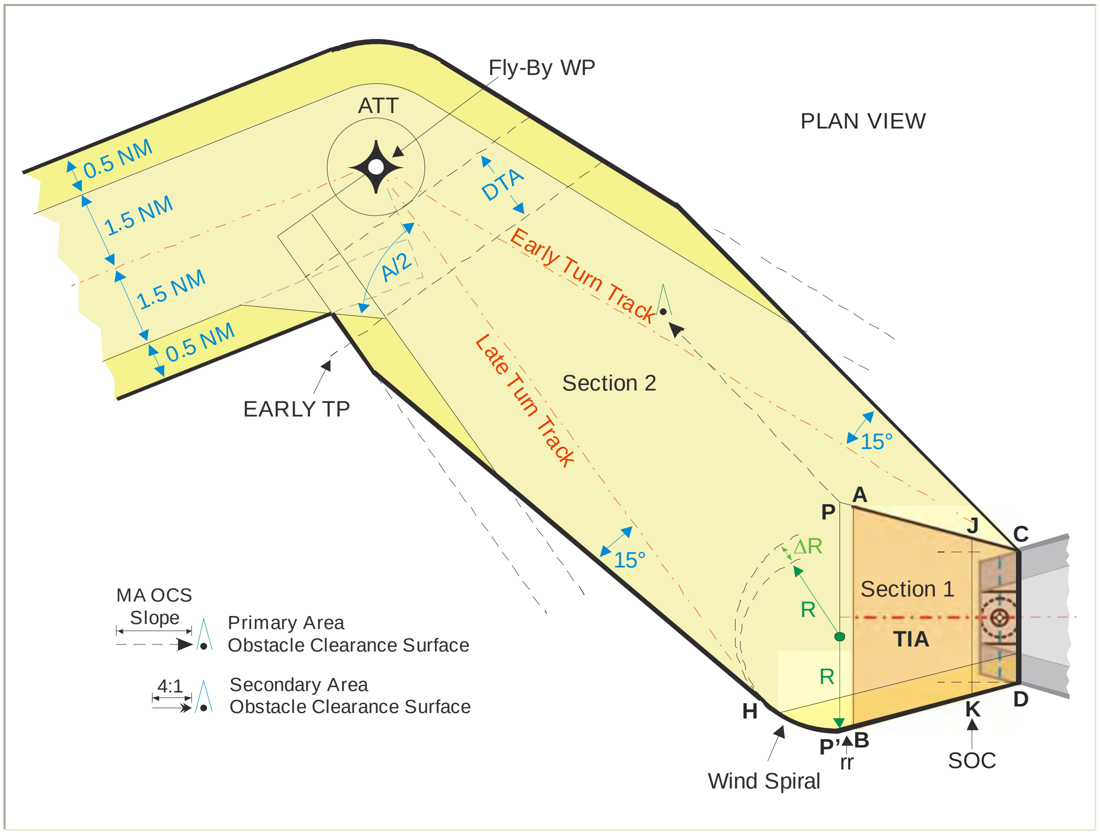


Figure 5-14. Direct to Fix Segment Following a TIA completion >75 degrees (Two WS).

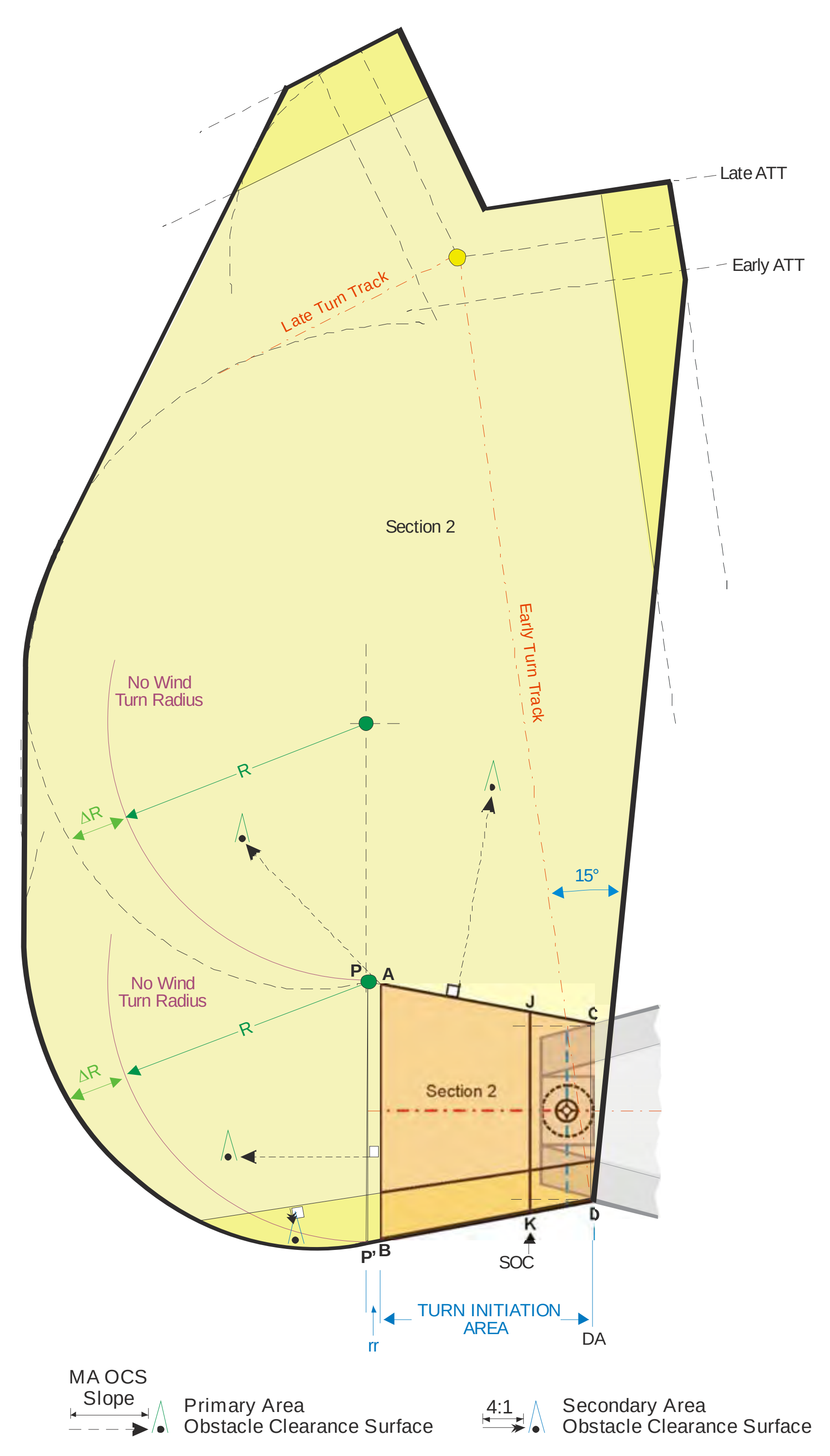


Figure 5-15. Direct to Fix Segment
Following a TIA completion > 165 degrees 3 WS.

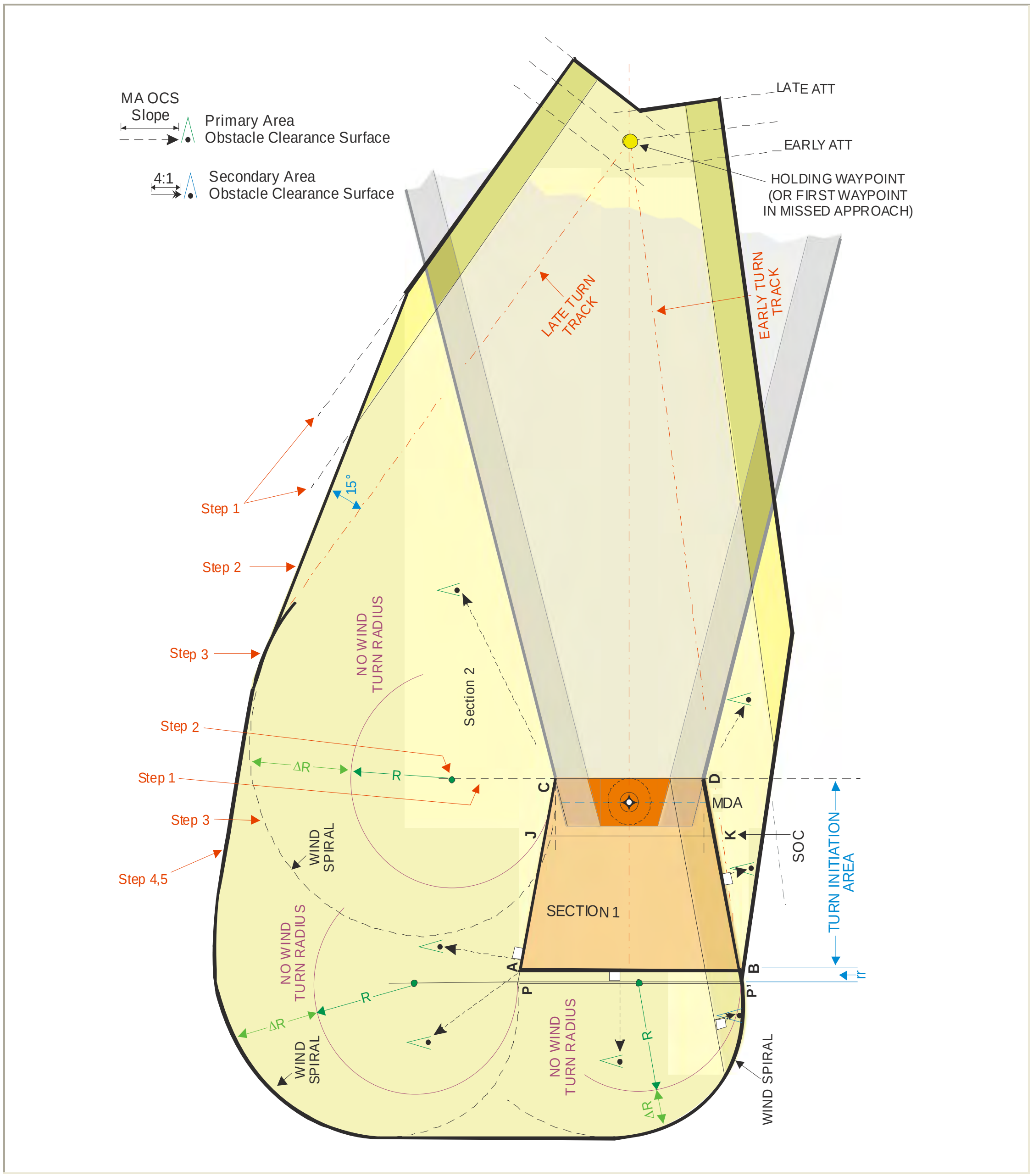


Figure 5-16. Fly-Over/Fly-By Diagrams.

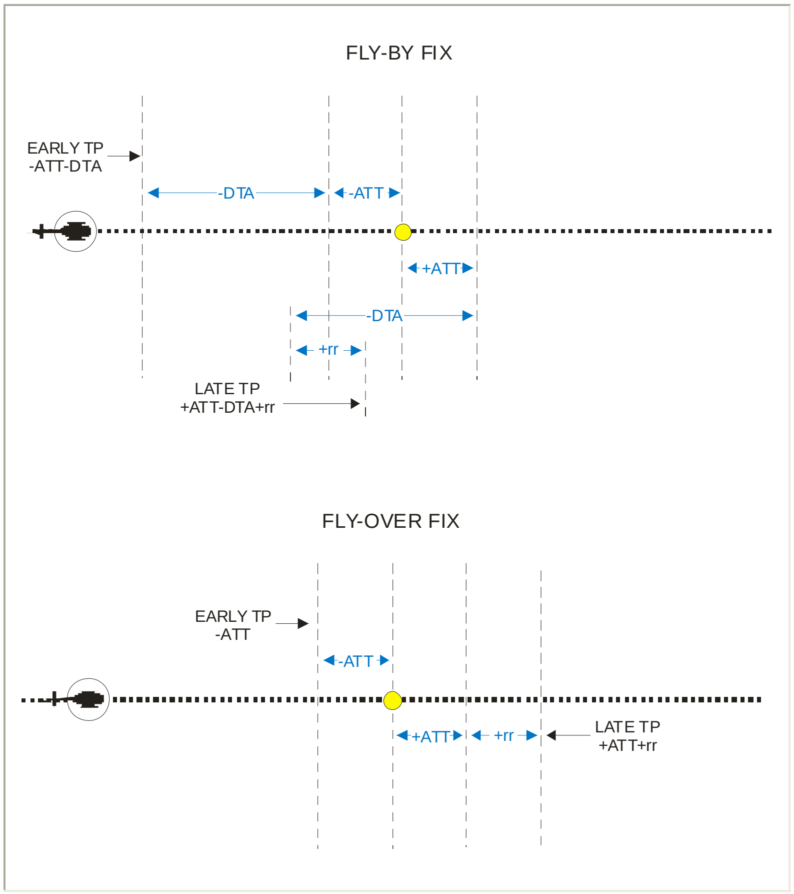


Figure 5-17. Turn at a Waypoint (fly-by).

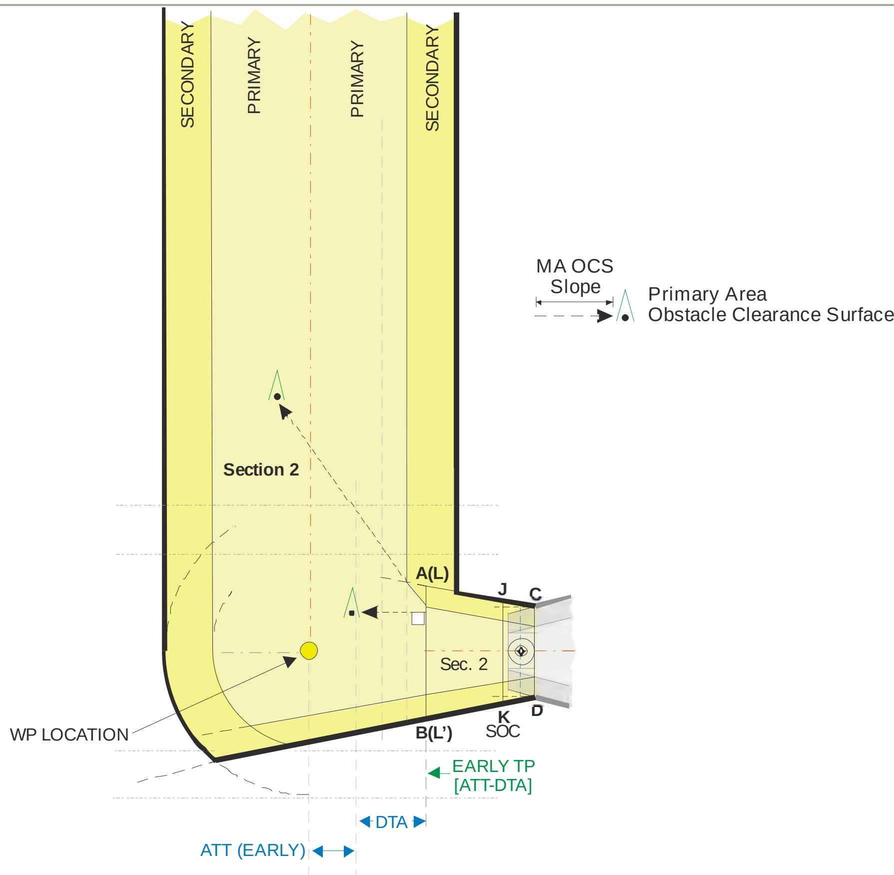


Figure 5-18a Turn at a Waypoint (fly-by).

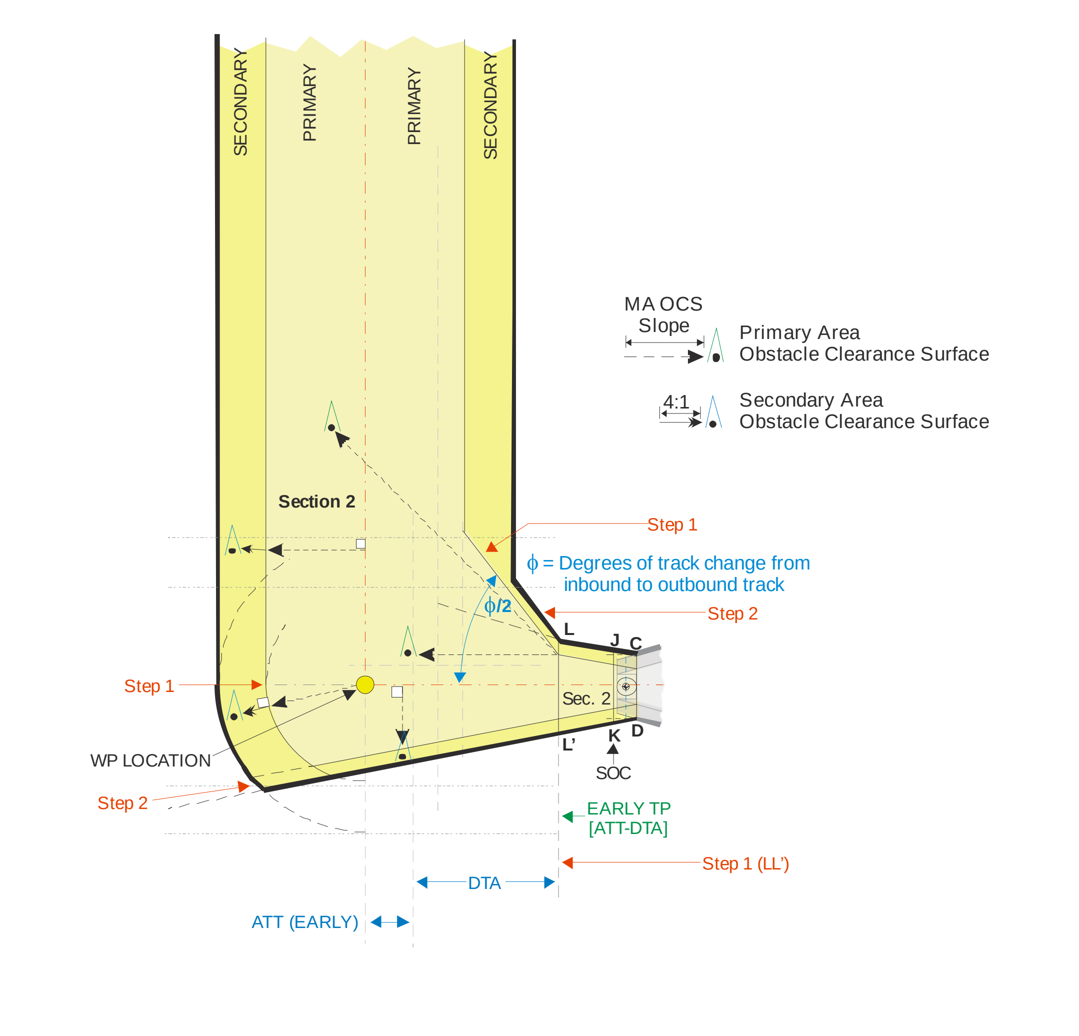


Figure 5-18b. Turn at a Waypoint (fly-by).

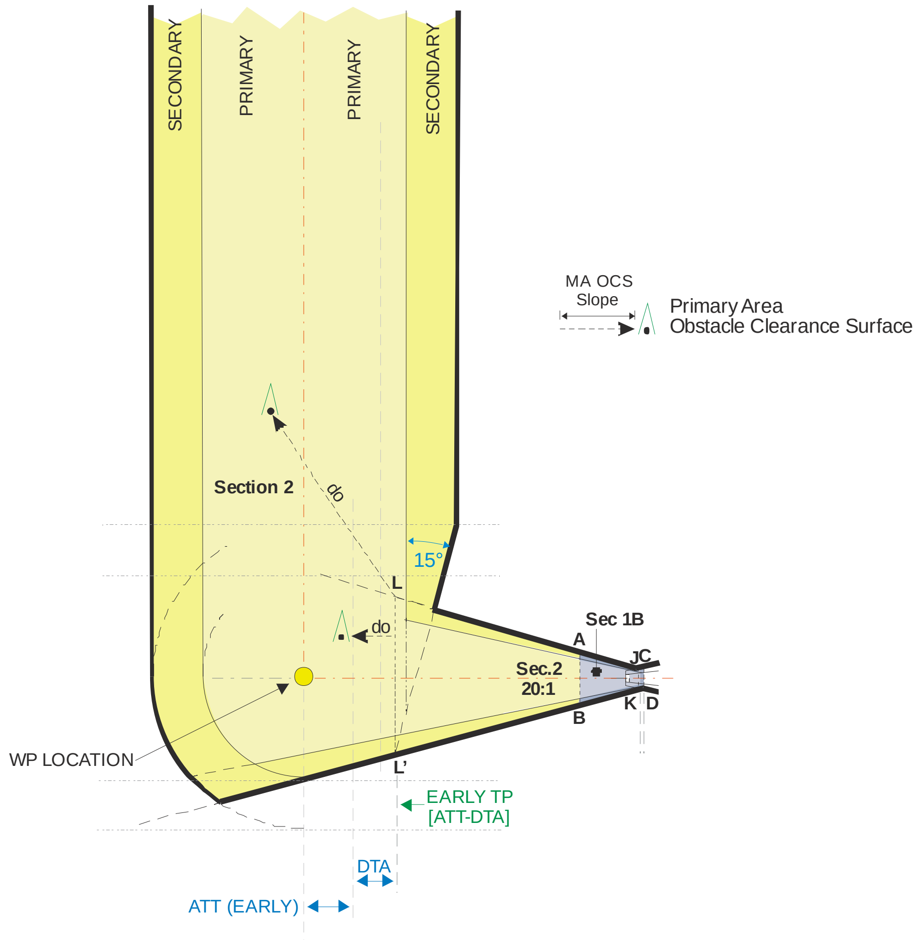


Figure 5-19. Turn at a Waypoint (fly-over) ≤ 75 Degrees.

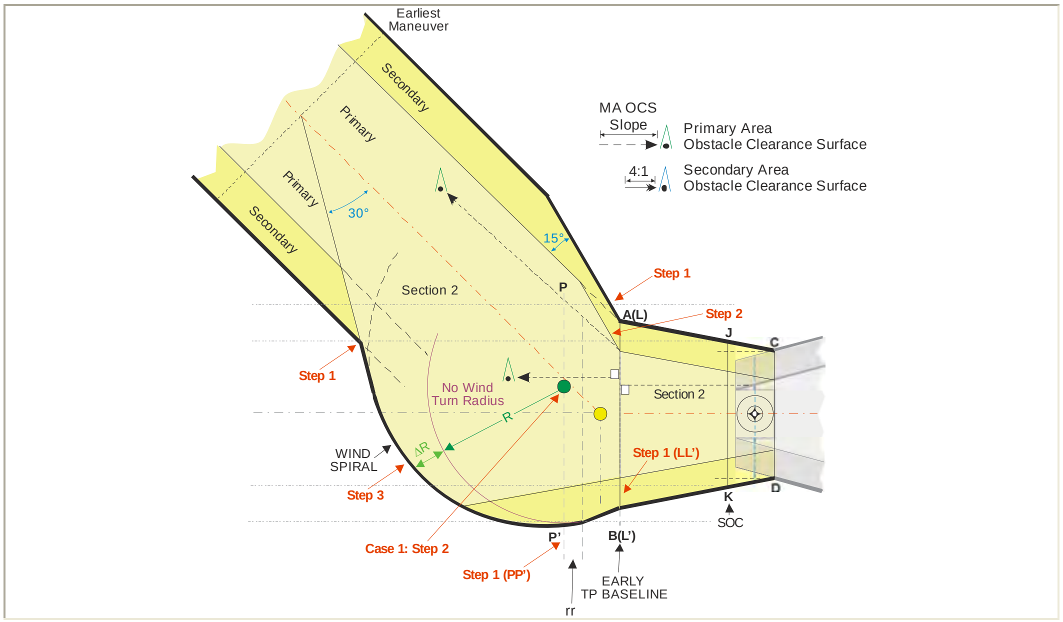


Figure 5-20. Turn at a Waypoint (fly-over) > 75 Degrees.

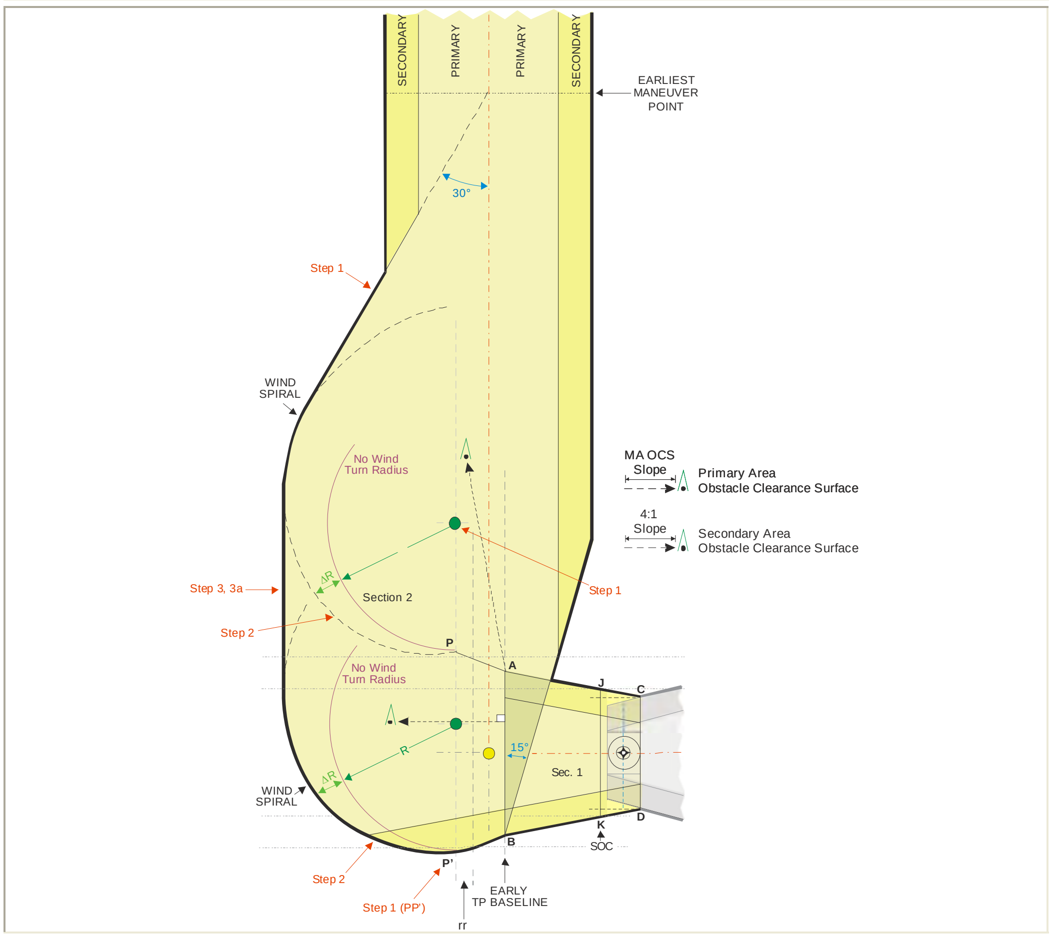


Figure 5-21. Second Turn Fly-By Construction.

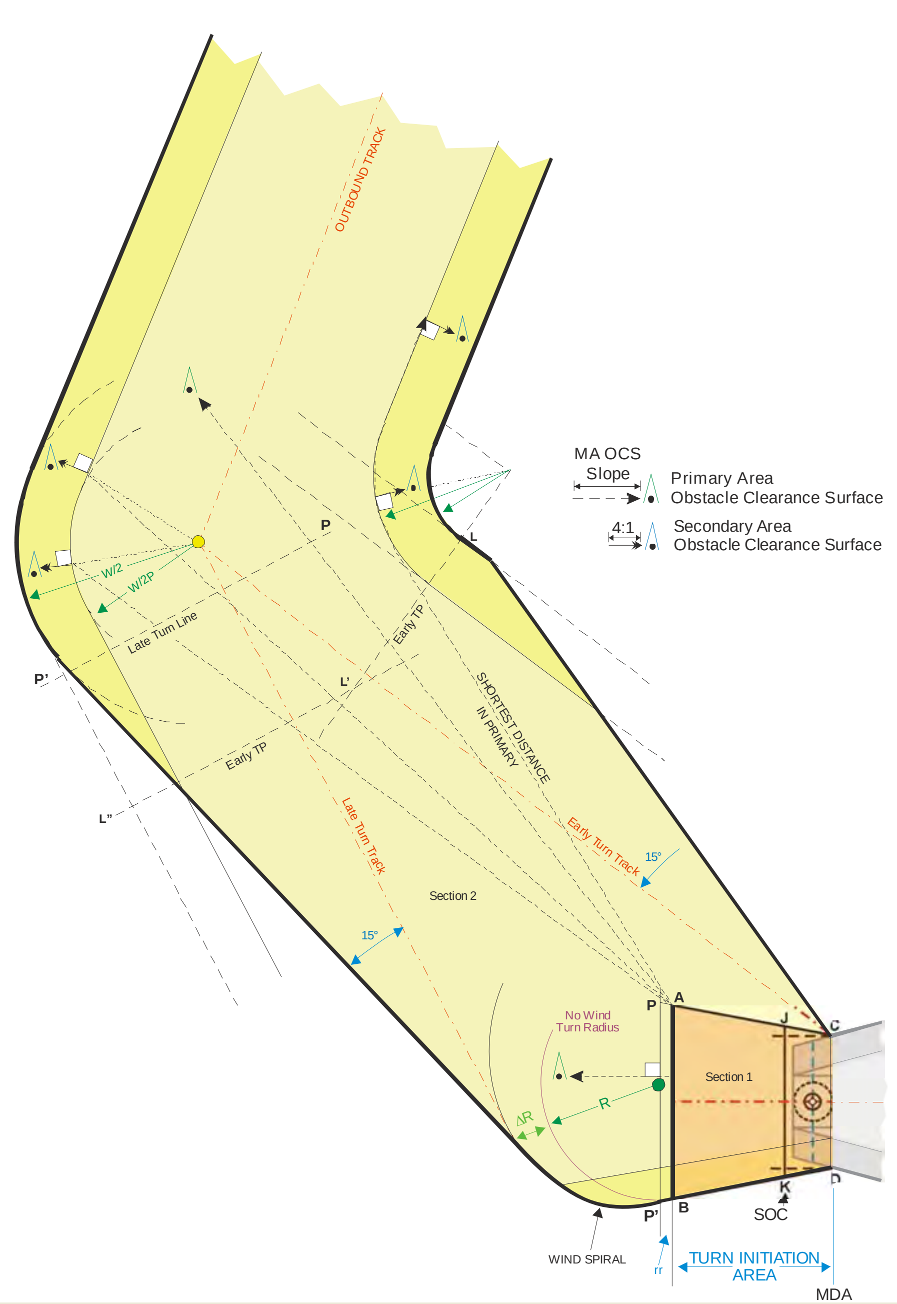


Figure 5-22. Second Turn Fly-Over Construction.

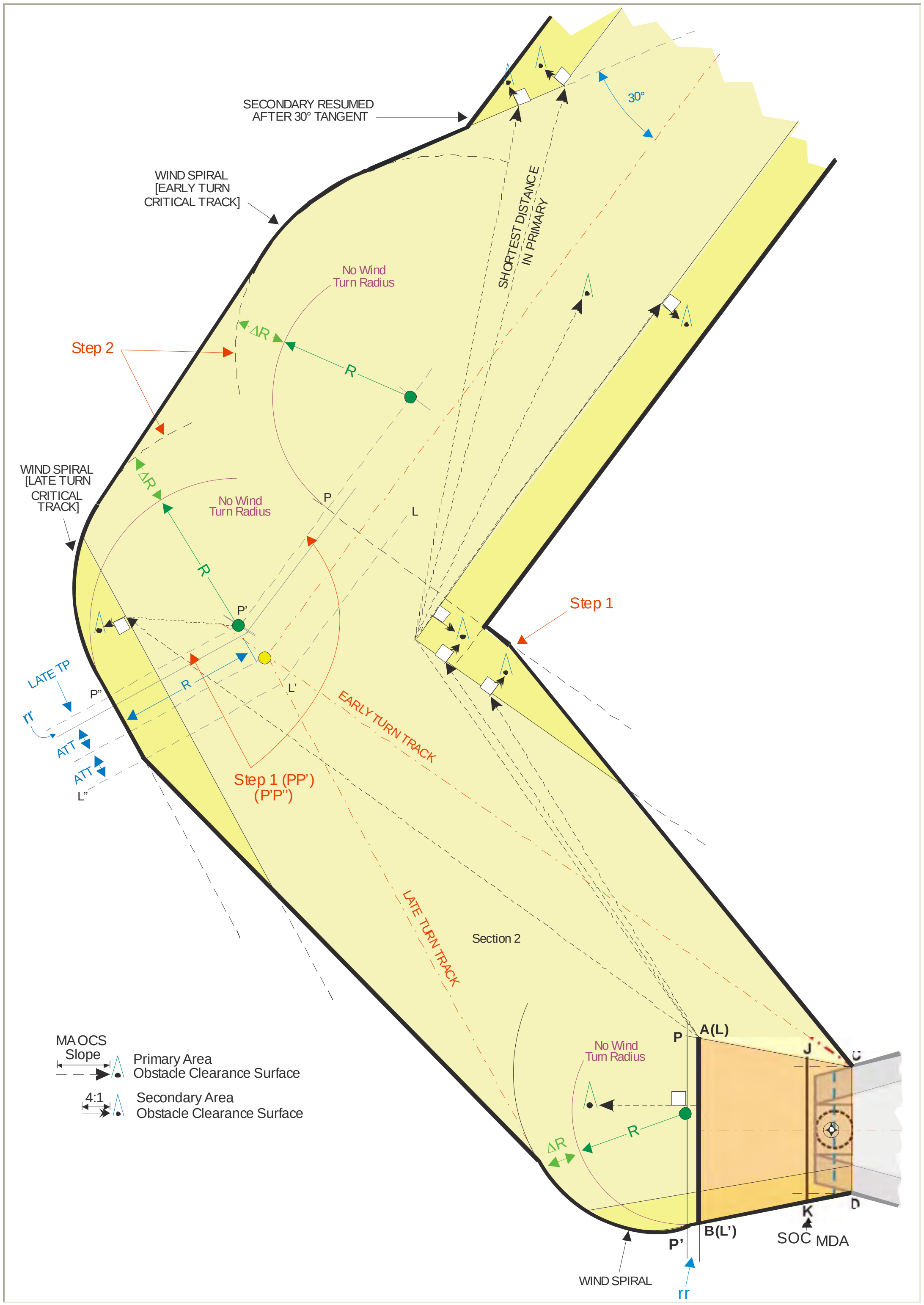


Figure 5-23. WS Connection (Inside Outbound Segment Primary Boundary).

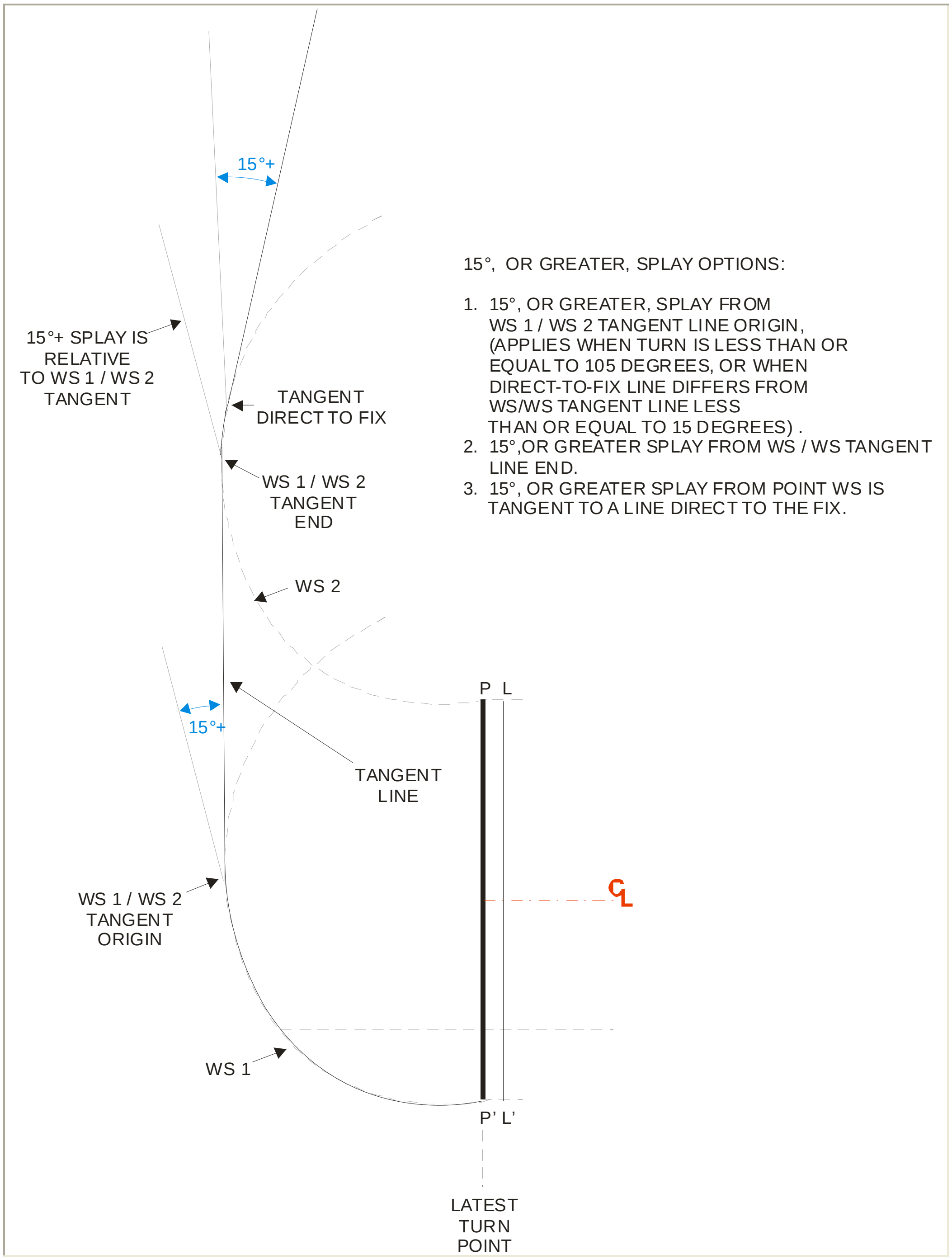


Figure 5-24. WS Connection (Inside Outbound Segment Primary Boundary).

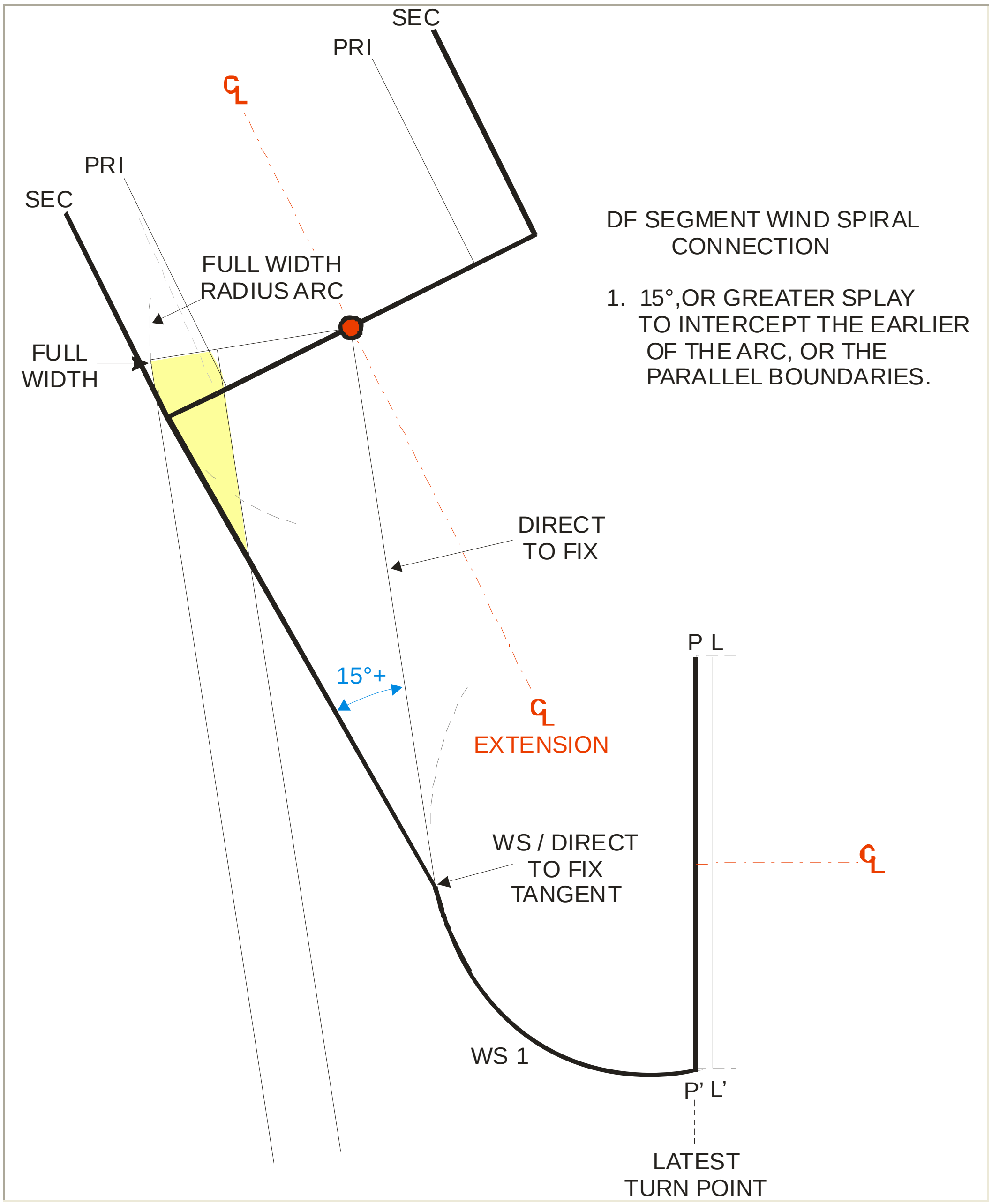
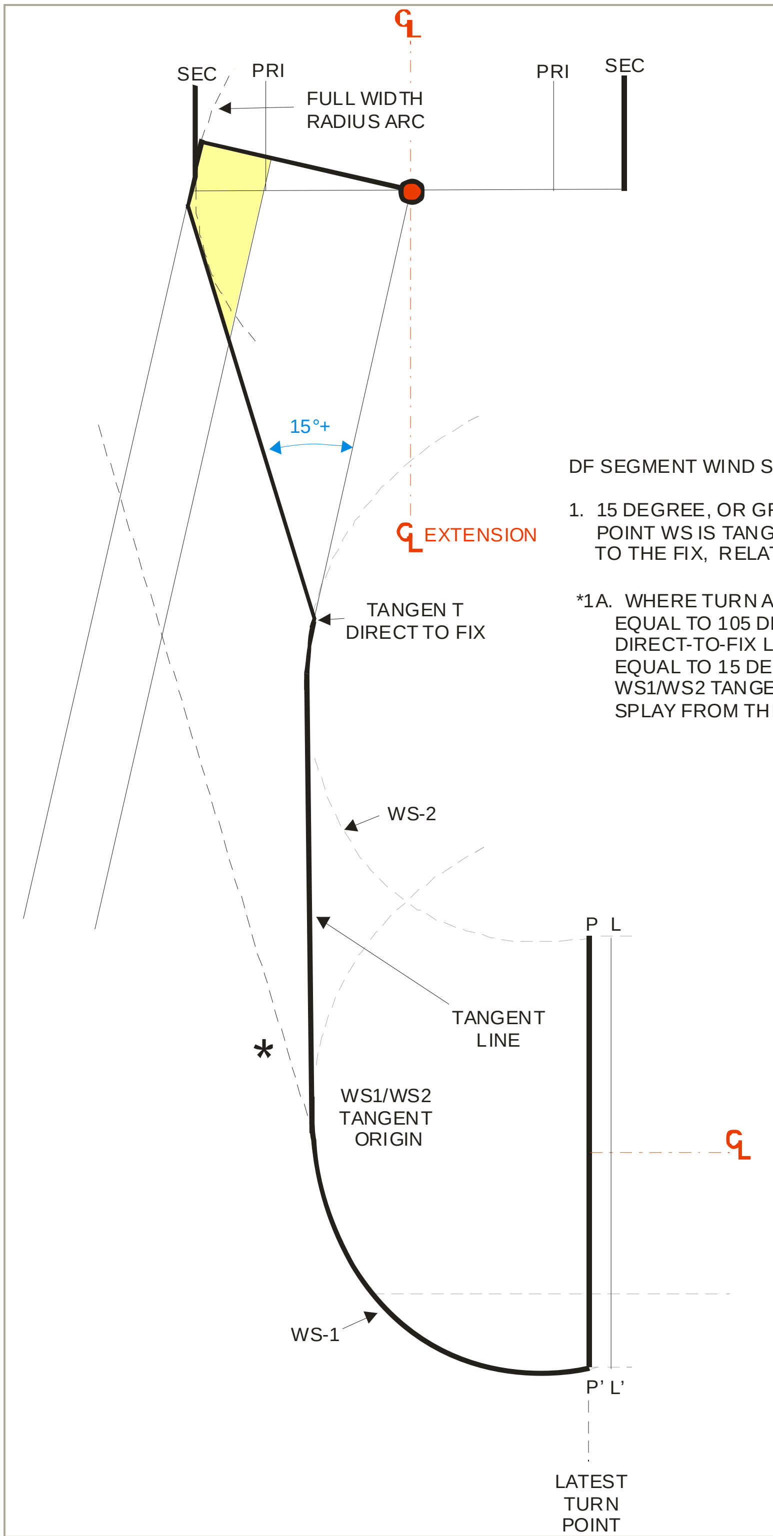


Figure 5-25. WS Connection (Inside Outbound Segment Secondary Boundary).



DF SEGMENT WIND SPIRAL CONNECTION

1. 15 DEGREE, OR GREATER SPLAY FROM POINT WS IS TANGENT TO A LINE DIRECT TO THE FIX, RELATIVE THE DIRECT TO FIX LINE.

*1A. WHERE TURN ANGLE IS LESS THAN OR EQUAL TO 105 DEGREES, OR WHERE THE DIRECT-TO-FIX LINE DIFFERS LESS THAN OR EQUAL TO 15 DEGREES FROM THE WS1/WS2 TANGENT LINE, APPLY THE SPLAY FROM THE WS1/WS2 TANGENT ORIGIN.

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Chapter 6. Helicopter Instrument Departure Design Criteria

6-1. General. See chapter 2, paragraph 1, section 1.

6-2. Terms. These terms/variables are common to all formulas:

β is magnitude of heading change in degrees
θ is glidepath angle in degrees
alt is altitude AMSL
ATT is along-track tolerance
DA is decision altitude specified AMSL
$\mathbf{d_{FauxOrigin}}$ is the distance from RDP to the phantom LTP for OEA construction
FTE means "Flight Technical Error"
HAS is the height in feet above the surface beneath (within 5,200 radius of) RDP
LTP means "landing threshold point"
MSL in this document is synonymous with AMSL
$\mathbf{OBS_{elev}}$ is the obstacle AMSL elevation
$\mathbf{OBS_x}$ is the along-track distance from reference datum point
$\mathbf{PFAF_{alt}}$ is the minimum AMSL altitude at the PFAF
RDP means "reference datum point"

$$\text{Functions and Constants}\left\{\begin{array}{l} \cdot\mathbf{deg} = \times\dfrac{\pi}{180} \\ \mathbf{fpnm} = \dfrac{1852}{0.3048} \\ \mathbf{max(a,b)} = \text{maximum value of a and b} \\ \mathbf{round(a,b)} = \text{rounds a to b decimal places} \\ \mathbf{ceiling(a)} = \text{rounds a to next integer toward positive infinity} \end{array}\right\}$$

6-3. Obstacle Departure Procedures. Reserved.

6-4. PinS Departures.

a. Background operational information for procedure designers. The PinS Departure Procedures (DPs) described in this criteria allow a pilot to depart a heliport and visually navigate and avoid obstacles to the Initial Departure Fix (IDF) where IFR obstruction clearance begins. The IDF is a FB WP. IFR helicopter departure procedures will consist of a defined route in graphic form, published/charted as a standard instrument departure (SID) and comply with design and documentation guidelines as specified in this chapter and FAA Order 8260.46 chapter 2, appendices A, C, D, and E.

b. General Procedure Design. Establish the IDF at a distance from 1.5 NM to 5.0 NM from HRP for Public DPs, and 0.55 NM to 2.0 NM for Special DPs. PCG and obstruction clearance must be provided from the earliest ATT at the IDF to the latest ATT at the last DP WP

(DP termination fix) where the DP joins the en route structure and an altitude that permits en route flight.

(1) Public DP Construction. Optimum leg length is 3.0 NM. If the magnitude (β) of the first turn is $\leq$ 70 degrees, the minimum leg length allowed is 3.0 NM. If β of the first turn is > 70 degrees the minimum leg length is 3.5 NM. Maximum turn magnitude is 90 degrees and leg length is 10.0 NM.

(2) Special DP Construction. The **optimum** leg length for Special helicopter DP construction is 3.0 NM. If β of the first turn angle is $\leq$ 30 degrees, the minimum leg length is 2.0 NM, if β of the first turn angles are > 30 degrees the minimum leg length increases to 3.0 NM. Maximum value for β is 90 degrees and maximum leg length is 10.0 NM.

(3) After the first turn fix, and expanding to full width, apply standard RNAV initial segment OEA construction for Category "A" aircraft. Minimum leg length is the greater of the current RNAV minimum leg length criteria or as construction requires after the first turn fix.

(4) Use Formula 6-1 to determine turn radius (R) and DTA appropriate for β. For a Public DP, use a design climb airspeed of 80 KIAS and a 13-degree bank angle until the climb trajectory reaches the target departure altitude. After the target departure altitude is reached, design for 140 KIAS and 15-degree bank angle. For a Special DP, use the best rate of climb airspeed (V_y), the cruising airspeed (V_c), and the design bank angle for V_y and V_c applicable to the specific design helicopter.

(5) If lower or higher airspeeds are required because of design helicopter performance or equipment operating limitations, publish a speed restriction.

Formula 6-1. Turn Radius/DTA

(1) *input* V_{KIAS}, $bank_{angle}$, $turn_{alt}$, β, HRP_{elev}

(2) $\text{case}(turn_{alt} - HRP_{elev} > 2000):\quad V_{KTW} = round(0.00198 \cdot turn_{alt} + 47, 0)$

$\text{case}(turn_{alt} - HRP_{elev} \leq 2000):\quad V_{KTW} = 30$

(3) $$V_{KTAS} = \text{round}\left[\frac{V_{KIAS} \cdot 171233 \cdot \sqrt{303 - 0.00198 \times turn_{alt}}}{(288 - 0.00198 \cdot turn_{alt})^{2.628}}, 0\right]$$

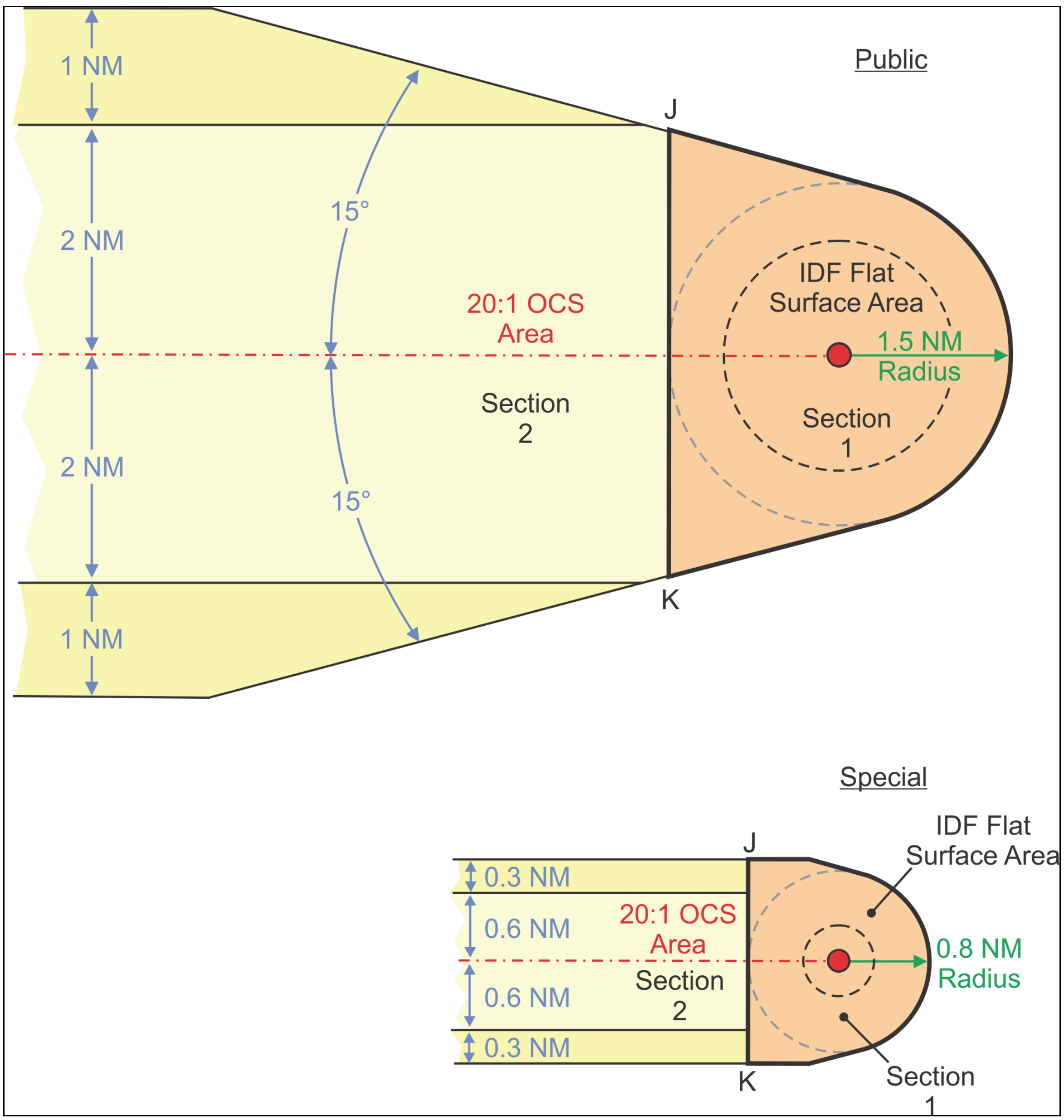
(4) $$R = \text{round}\left[\frac{(V_{KTAS} + V_{KTW})^2}{\tan(bank_{angle}{}^{\circ}) \cdot 68625.4}, 2\right]$$

(5) $$DTA_{NM} = \text{round}\left[R \cdot \tan\left(\frac{\beta^{\circ}}{2}\right), 2\right]$$

if ($turn_{alt}$-HRP_{elev}>2000) then 0.00198*$turn_{alt}$+47 else 30 round((V_{KIAS}*171233*(303-0.00198*$turn_{alt}$)^0.5)/(288-0.00198*$turn_{alt}$)^2.628,0) round((V_{KTAS}+V_{KTW})^2/(tan($bank_{angle}$*π/180)*68625.4),2) round(R*tan(β/2*π/180),2)		
Calculator		
V_{KIAS}		Click Here to calculate
$bank_{angle}$		
$turn_{alt}$		
β		
HRP_{elev}		
V_{KTW}		
R		
DTA		

6-5. Obstacle Evaluation Area. The OEA consists of Section 1 (the IDF flat surface area), and Section 2 (the 20:1 sloping OCS), as shown in Figure 6-1. The JK line (end of section 1/ beginning of section 2) is a line perpendicular to the initial departure course that is a specified distance from the IDF: 1.5 NM (1 NM ATT + 0.5 NM FTE) for public DPs and 0.8 NM (0.3 NM ATT + 0.5 NM FTE) for Specials the construction radius around the IDF is 1 NM ATT + 0.5 NM FTE = 1.5 NM for a Public DP and 0.3 NM + 0.5 NM FTE = 0.8 NM for a Special DP. A 15-degree splay defines the Section 1 and Section 2 outer boundaries as shown in Figure 6-1 below. The OEA entry is centered on the IDF and the route is constructed as a series of TF legs to the DP termination fix.

Figure 6-1. Section 1 Flat Surface, Section 2 OCS Areas



6-6. General Public PinS Departure Construction. For Public DP construction, OEA configuration is dependent on the course change angle at the first turn fix, and the length of the first segment. Some examples are illustrated in Figure 6-2 thru Figure 6-4. Instructions on how to define these cases (creating the specific OEAs and turn boundaries) are located in steps below:

Figure 6-2. Public OEA Area Plan View (90-Degree Turn)

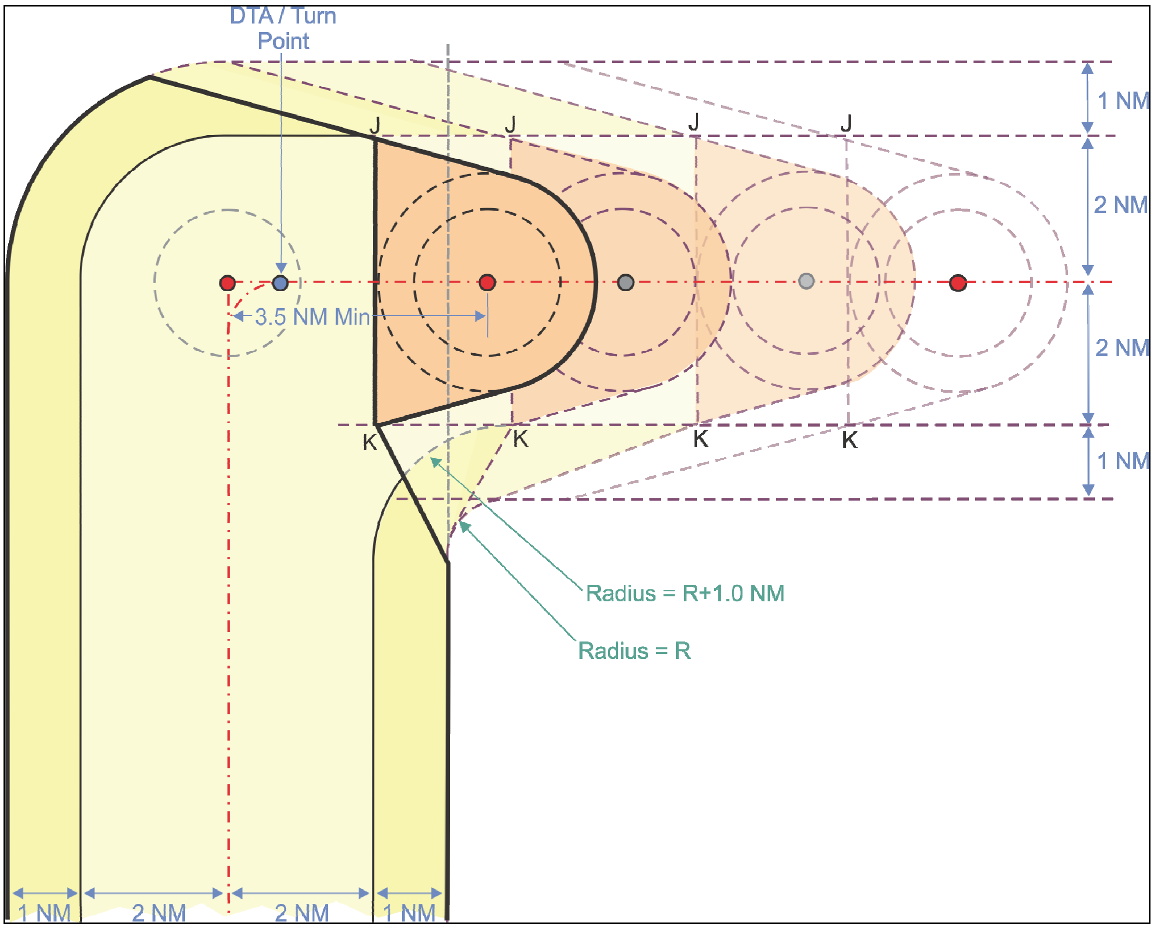


Figure 6-3. Public OEA Area Plan View (15- and 30-Degree Turns)

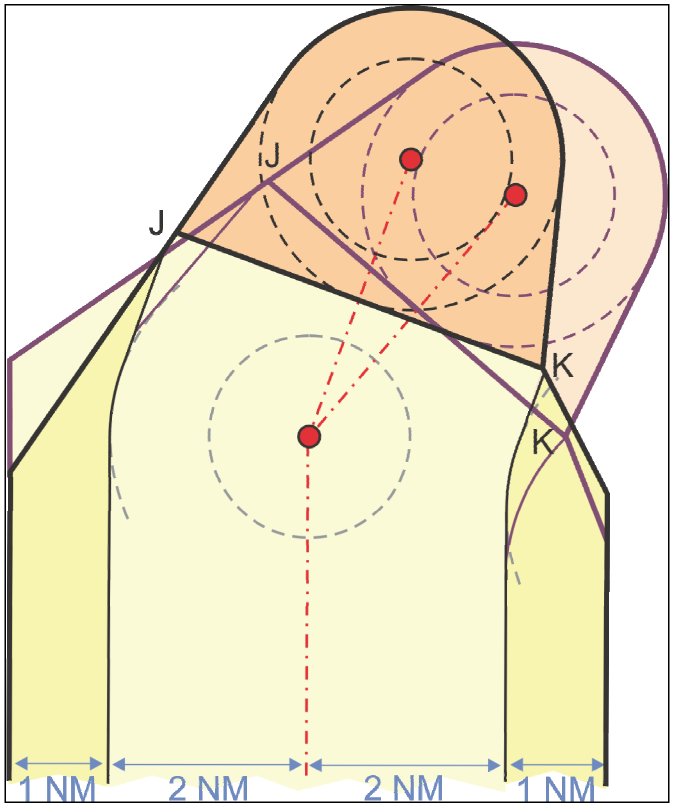
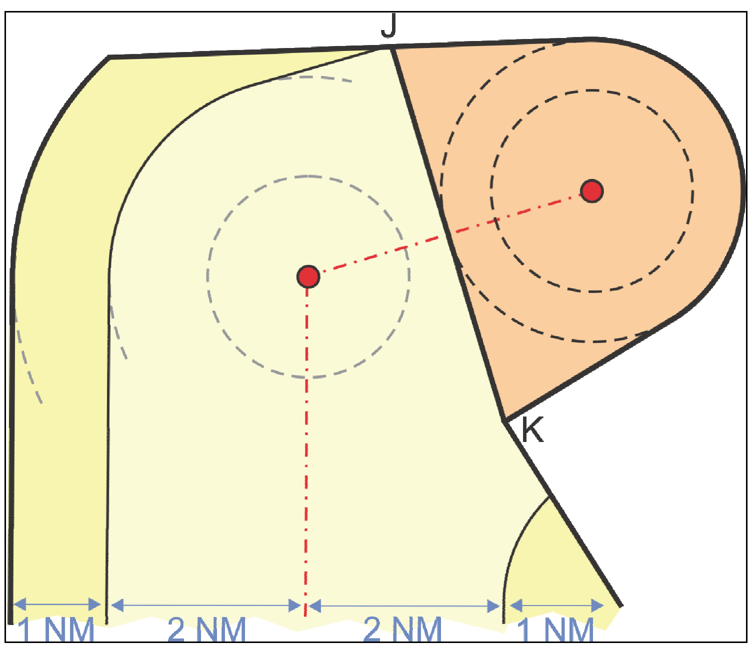


Figure 6-4. Public OEA Area Plan View (70-Degree Turn)



Step 1: Position the IDF as a FB fix. Use a fix-to-fix distance that is in accordance with chapter 2, paragraph 2b(1).

Step 2: Construct the IDF Circle as an arc with a 1.5 NM radius centered at the IDF fix.

Step 3: Construct the Designed Turning Flight Path.

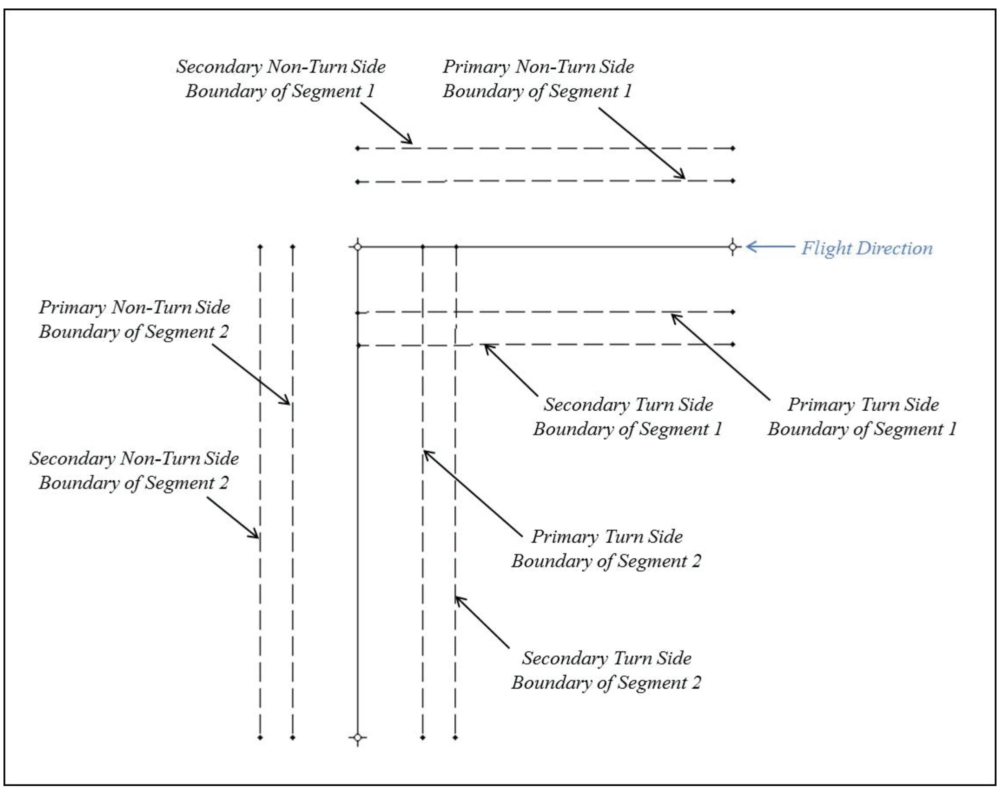
Step 3a: Determine the turn radius (R) utilizing Formula 6-1.

Step 3b: Construct an arc of radius R that lays tangent to Segments 1 and 2.

Step 4: Construct Segment 1 Boundaries. Construct Boundaries of half-widths 1-2-2-1 in reference to Segment 1. They will hereby be referred to as the Secondary Turn Side Boundary of Segment 1, the Primary Turn Side Boundary of Segment 1, the Primary Non-Turn Side Boundary of Segment 1, and the Secondary Non-Turn Side Boundary of Segment 1. These boundaries are depicted in Figure 6-5.

Step 5: Construct Segment 2 Boundaries. Construct Boundaries of half-widths 1-2-2-1 in reference to Segment 2. They will hereby be referred to as the Secondary Turn Side Boundary of Segment 2, the Primary Turn Side Boundary of Segment 2, the Primary Non-Turn Side Boundary of Segment 2, and the Secondary Non-Turn Side Boundary of Segment 2. These boundaries are depicted in Figure 6-5.

Figure 6-5. Construction of the Segment 1 and Segment 2 Boundaries



Step 6: Construct the Turn Side Splay Line (see Figure 6-6).

Step 6a: Locate the Splay End Reference Point a distance of 1.5/tan(15°) NM from the IDF along the Segment 1 Course Line.

Step 6b: Locate the Turn Side Splay Line End Point as the Splay End Reference Point projected onto the Secondary Turn Side Boundary of Segment 1.

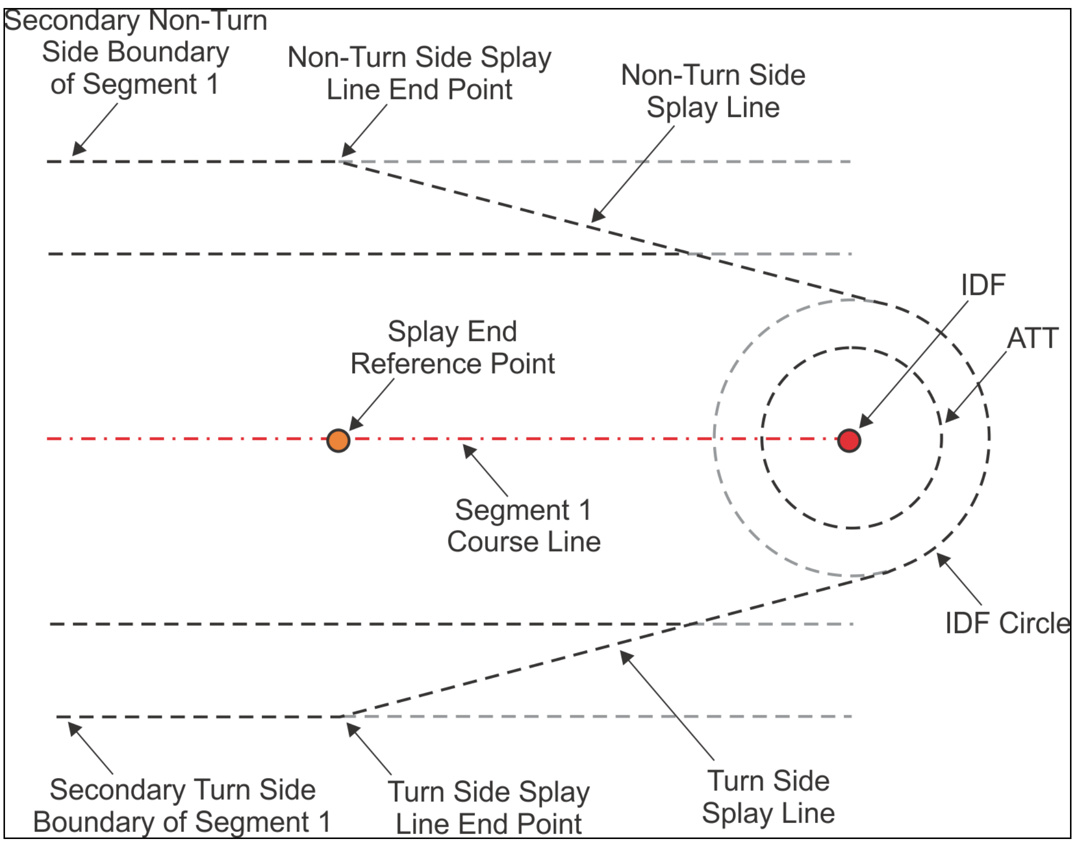
Step 6c: Construct the Turn Side Splay Line as a line that is tangent to the IDF Circle passing through the Turn Side Splay Line End Point.

Step 7: Construct the Non-Turn Side Splay Line (see Figure 6-6).

Step 7a: Locate the Non-Turn Side Splay Line End Point as the Splay End Reference Point projected onto the Secondary Non-Turn Side Boundary of Segment 1.

Step 7b: Construct the Non-Turn Side Splay Line as a line that is tangent to the IDF Circle passing through the Non-Turn Side Splay Line End Point.

Figure 6-6. Construction of the Splay Lines



Step 8: Construct the IDF Flat Surface Area (see Figure 6-7).

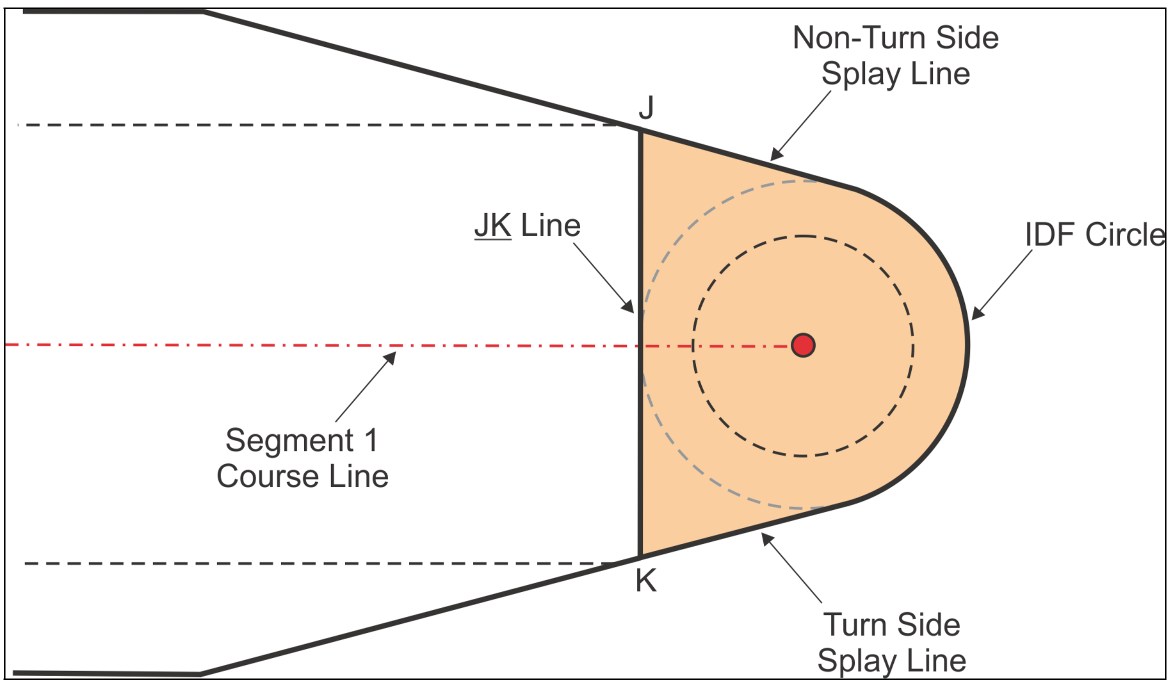
Step 8a: Construct the JK line as a line that lays tangent to the IDF Circle at a point intersecting the Segment 1 Course Line.

Step 8b: Truncate the JK line where it intersects the Turn Side Splay Line and the Non-Turn Side Splay Line.

Step 8c: The IDF Flat Surface Area is the area bounded by the IDF Circle, the Turn Side and Non-Turn Side Splay Lines, and the JK line.

Step 8d: The Turn Side end of the JK line will hereby be referred to as Point J and the Non-Turn Side end of the JK line will hereby be referred to as Point K.

Figure 6-7. Construction of the IDF Flat Surface Area

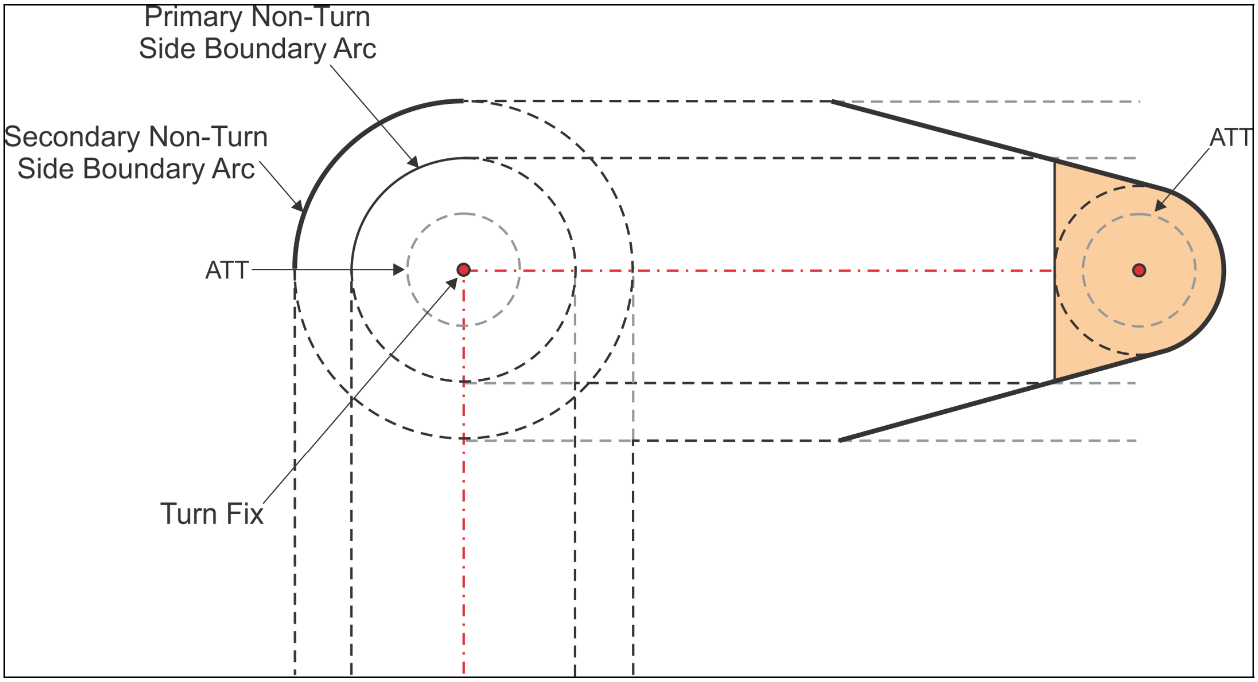


Step 9: Construct Non-Turn Side Boundary Arcs (see Figure 6-8).

Step 9a: Construct the Primary Non-Turn Side Boundary Arc centered on the turn fix with a radius equal to the Segment 1 primary half-width.

Step 9b: Construct the Secondary Non-Turn Side Boundary Arc centered on the turn fix with a radius equal to the Segment 1 primary half-width plus the segment secondary width.

Figure 6-8. Construction of the Non-Turn Side Boundary Arcs

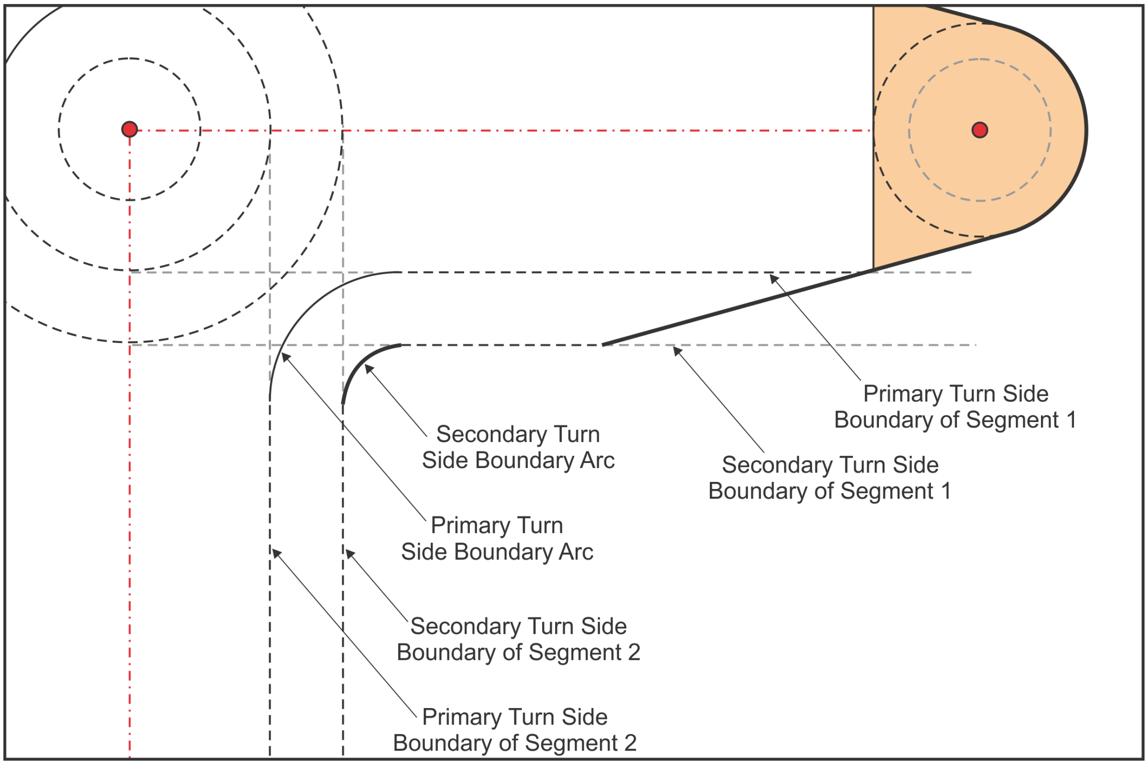


Step 10: Construct Turn Side Boundary Arcs (see Figure 6-9).

Step 10a: Construct the Primary Turn Side Boundary Arc tangent to the Primary Turn Side Boundaries of Segments 1 and 2 with a radius equal to R + 1 NM.

Step 10b: Construct the Secondary Turn Side Boundary Arc tangent to the Secondary Turn Side Boundaries of Segments 1 and 2 with a radius equal to R.

Figure 6-9. Construction of the Turn Side Boundary Arcs



Step 11: Define and Construct the Non-Turn Side Boundary.

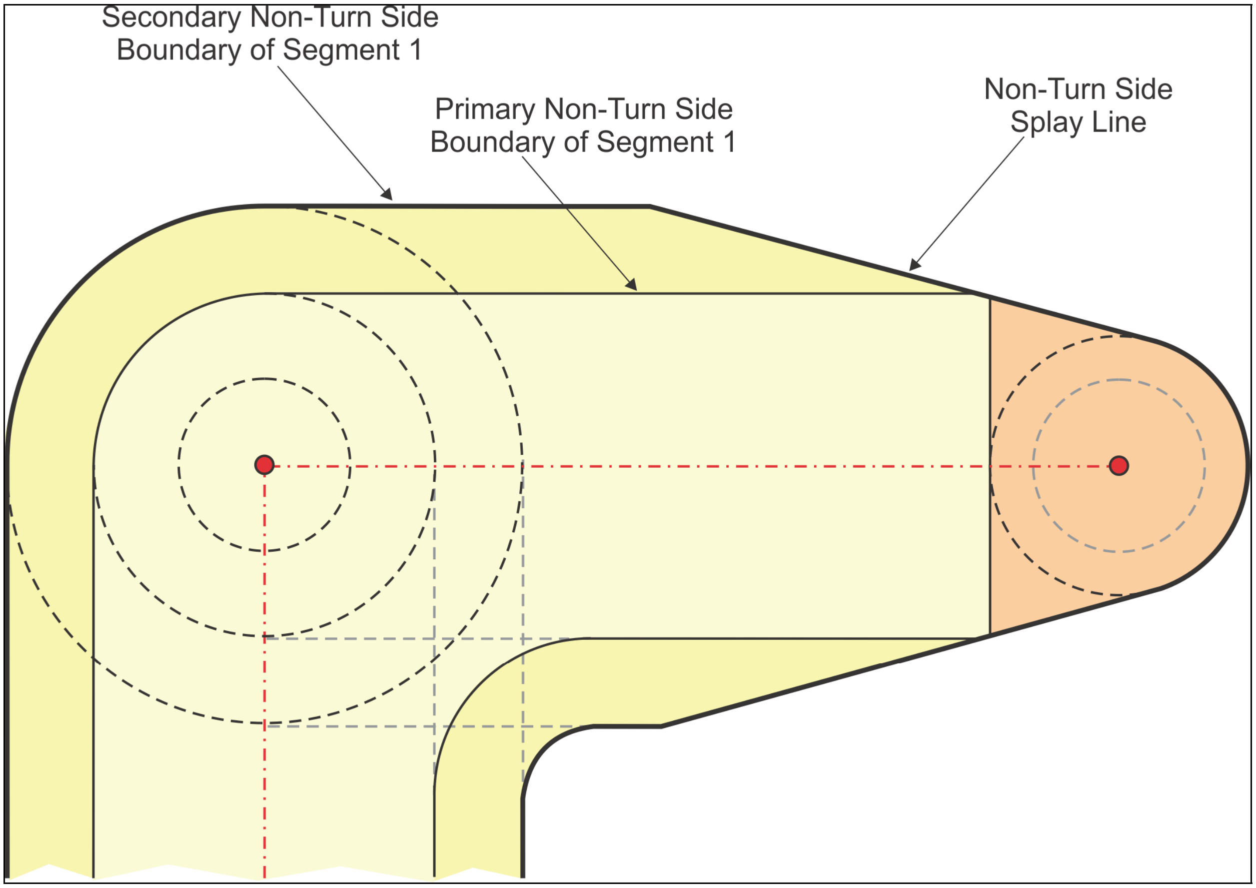
Step 11a: Depending on the course change at the second waypoint and the length of Segment 1, the Non-Turn Side Splay Line will either intersect the Secondary Non-Turn Side Boundary of Segment 1, the Secondary Non-Turn Side Boundary Arc, or the Secondary Non-Turn Side Boundary of Segment 2.

Step 11b: If the Non-Turn Side Splay Line intersects the Secondary Non-Turn Side Boundary of Segment 1 (see Figure 6-10), then:

Step 11b (1): Truncate the Secondary Non-Turn Side Boundary of Segment 1 at the intersection, and,

Step 11b (2): Truncate the Primary Non-Turn Side Boundary of Segment 1 where it intersects the Non-Turn Side Splay Line.

Figure 6-10. Construction of the Non-Turn Side Boundary, Case 1



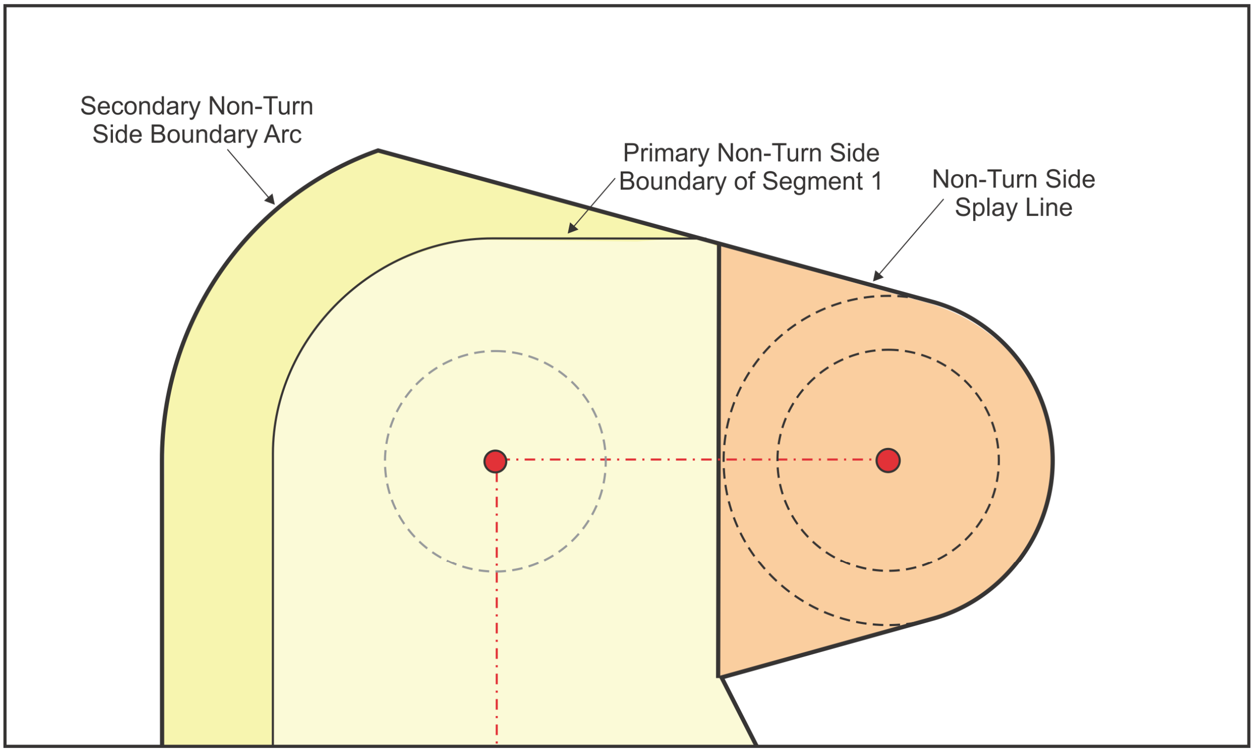
Step 11c: If the Non-Turn Side Splay Line intersects the Secondary Non-Turn Side Boundary Arc (see Figure 6-2) then,

Step 11c (1): Remove the Secondary Non-Turn Side Boundary of Segment 1,

Step 11c (2): Truncate the Secondary Non-Turn Side Boundary Arc at the intersection and,

Step 11c (3): Truncate the Primary Non-Turn Side Boundary of Segment 1 where it intersects the Non-Turn Side Splay Line.

Figure 6-11. Construction of the Non-Turn Side Boundary, Case 2



Step 11d: If the Non-Turn Side Splay Line intersects the Secondary Non-Turn Side Boundary of Segment 2 (see Figure 6-12) then,

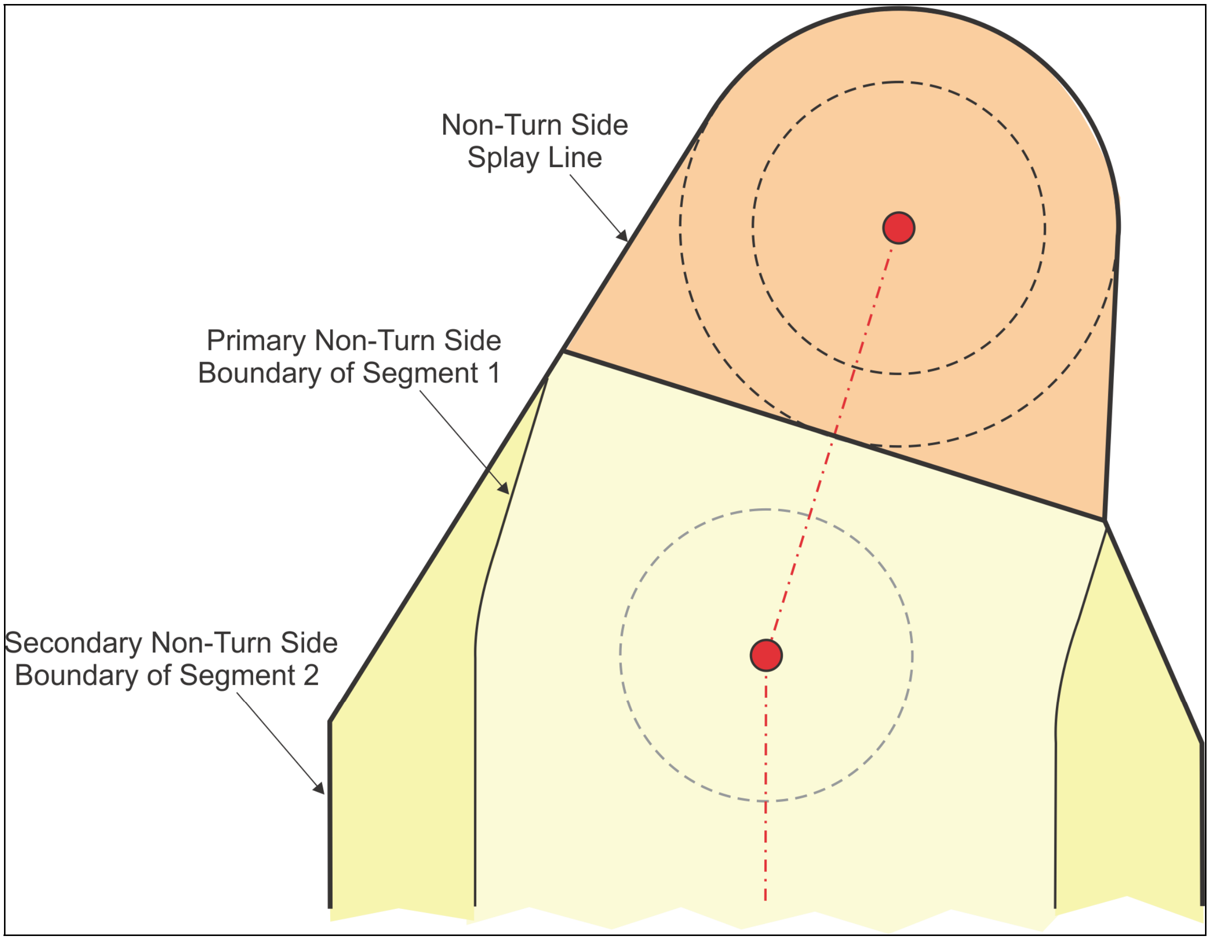
Step 11d (1): Remove the Secondary Non-Turn Side Boundary of Segment 1,

Step 11d (2): Remove the Secondary Non-Turn Side Boundary Arc,

Step 11d (3): Truncate the Secondary Non-Turn Side Boundary of Segment 2 at the intersection and,

Step 11d (4): Truncate the Primary Non-Turn Side Boundary of Segment 1 where it intersects the Non-Turn Side Splay Line.

Figure 6-12. Construction of the Non-Turn Side Boundary, Case 3



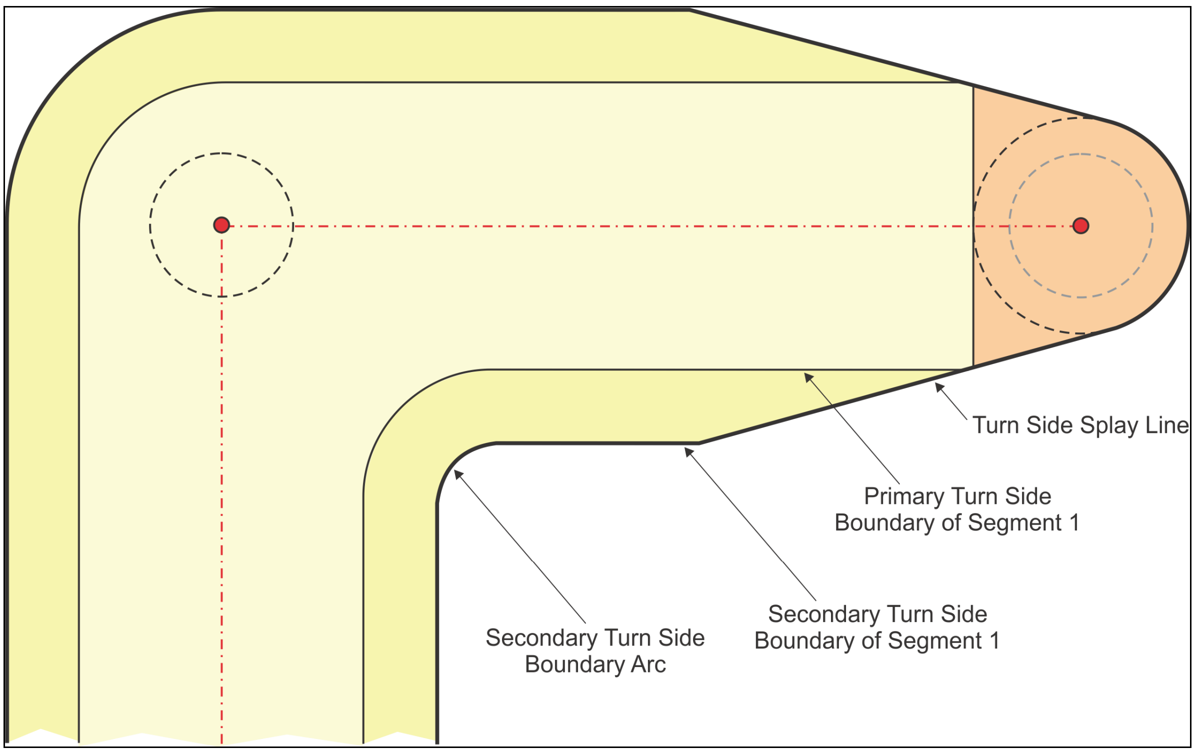
Step 12: Define and Construct the Turn Side Boundary.

Step 12a: If the Turn Side Splay Line intersects the Secondary Turn Side Boundary of Segment 1 before the start of the Secondary Turn Side Boundary Arc (see Figure 6-13) then,

Step 12a (1): Truncate the Primary Turn Side Boundary of Segment 1 at its intersection with the Turn Side Splay Line and,

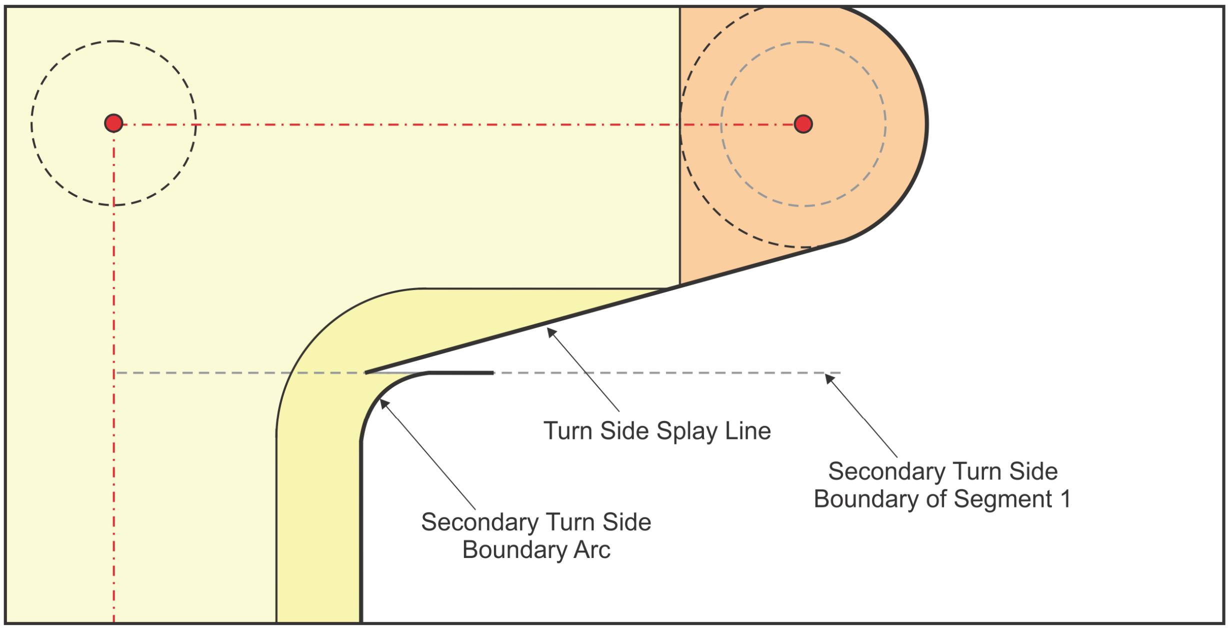
Step 12a (2): Truncate the Secondary Turn Side Boundary of Segment 1 at its intersection with the Turn Side Splay Line.

Figure 6-13. Construction of the Turn Side Boundary, Case 1



Step 12b: If the Turn Side Splay Line intersects the Secondary Turn Side Boundary of Segment 1 after the start of the Secondary Turn Side Boundary Arc (see Figure 6-14) then,

Figure 6-14. Construction of the Turn Side Boundary, Case 2 Determination



Step 12b (1): Construct the Turn Side Boundary Line as a line that lays tangent to the Secondary Turn Side Boundary Arc and passes through Point K.

Step 12b (1)(a): If the configuration of the procedure is such that this step cannot be performed, forego this step and proceed to Step 12c.

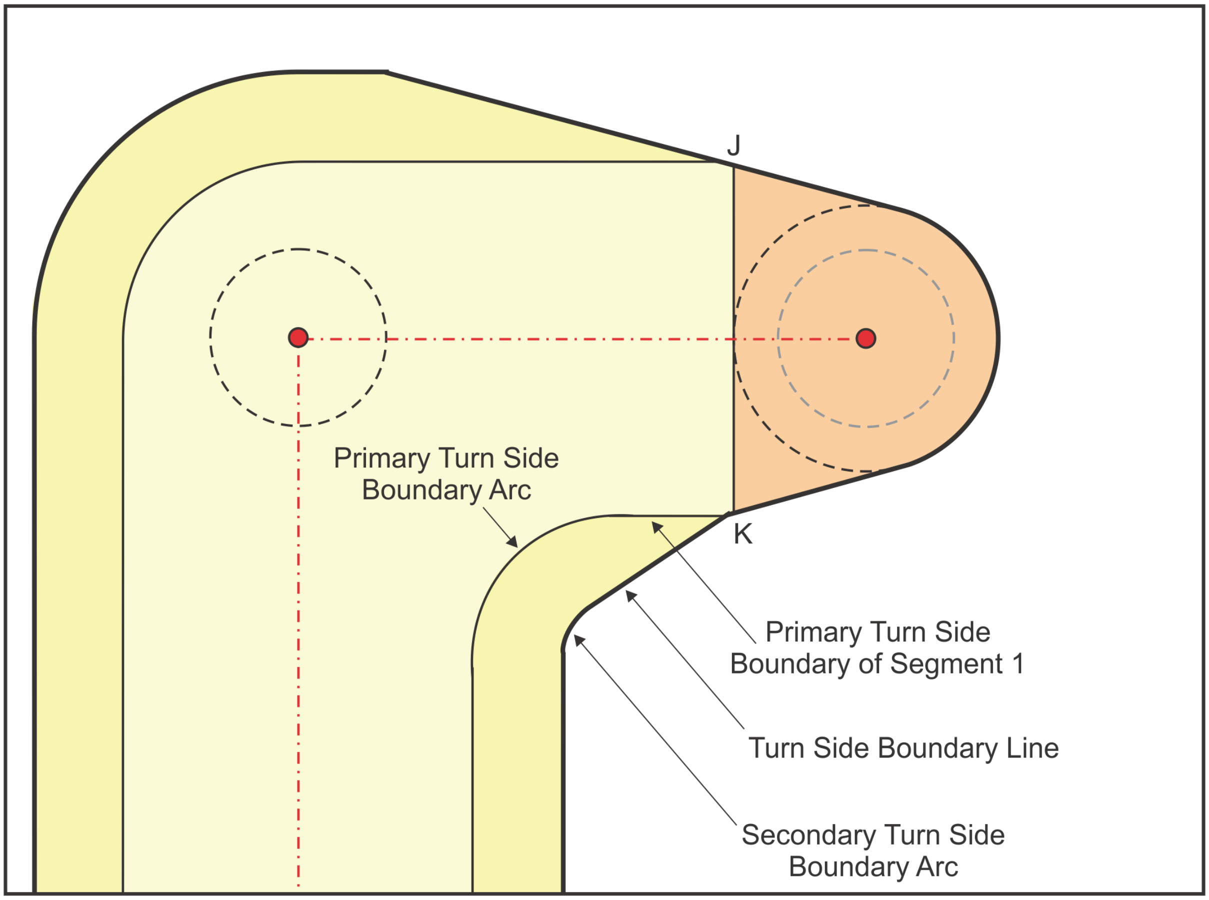
Step 12b (2): If the Turn Side Boundary Line intersects the Primary Turn Side Boundary of Segment 1 (see Figure 6-15) then,

Step 12b (2)(a): Truncate the Primary Turn Side Boundary of Segment 1 at its intersection with the Turn Side Boundary Line,

Step 12b (2)(b): Remove the Secondary Turn Side Boundary of Segment 1, and

Step 12b (2)(c): Truncate the Secondary Turn Side Boundary Arc at its point of tangency with the Turn Side Boundary Line.

Figure 6-15. Construction of the Turn Side Boundary, Case 2a



Step 12b (3): If the Turn Side Boundary Line intersects the Primary Turn Side Boundary Arc (see Figure 6-16) then,

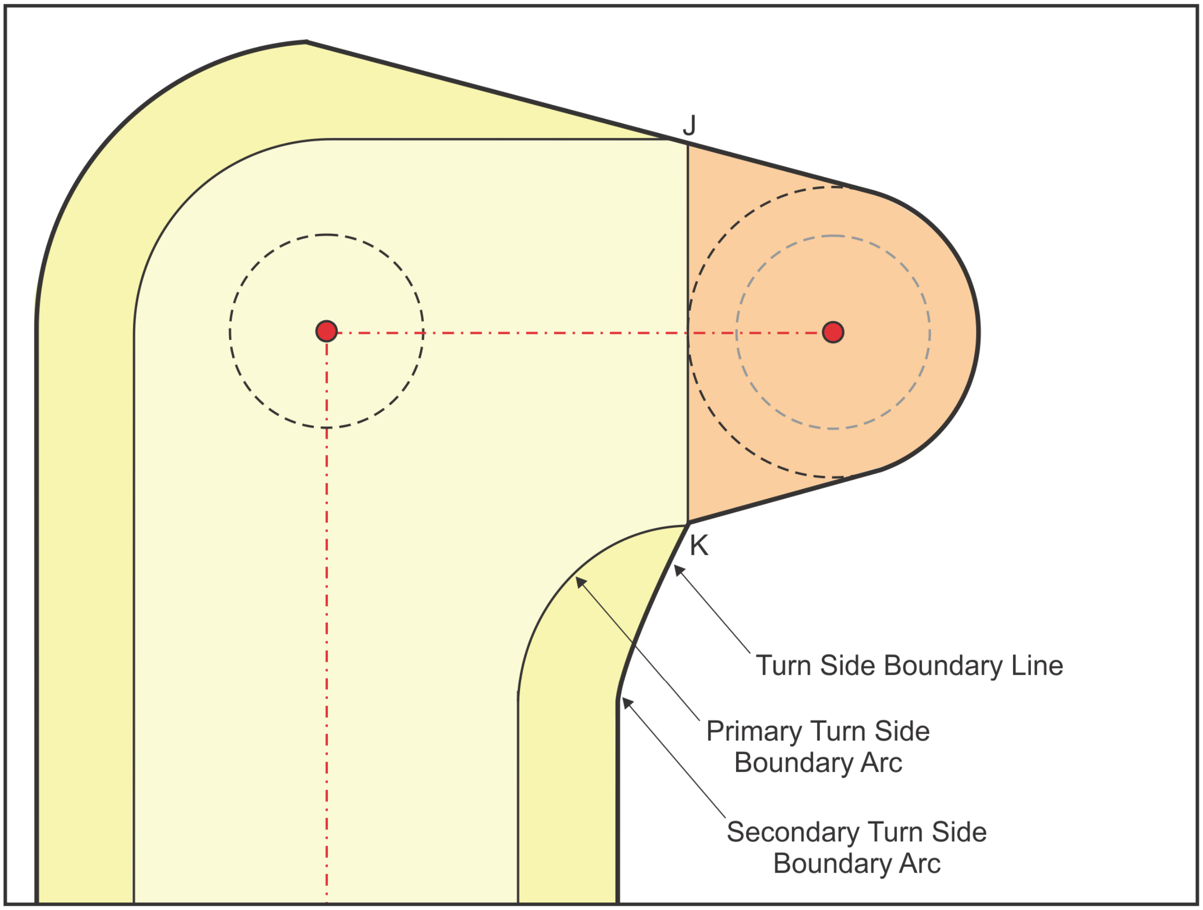
Step 12b (3)(a): Truncate the Primary Turn Side Boundary Arc at its intersection with the Turn Side Boundary Line,

Step 12b (3)(b): Truncate the Secondary Turn Side Boundary Arc at its point of tangency with the Turn Side Boundary Line,

Step 12b (3)(c): Remove the Primary Turn Side Boundary of Segment 1, and

Step 12b (3)(d): Remove the Secondary Turn Side Boundary of Segment 1.

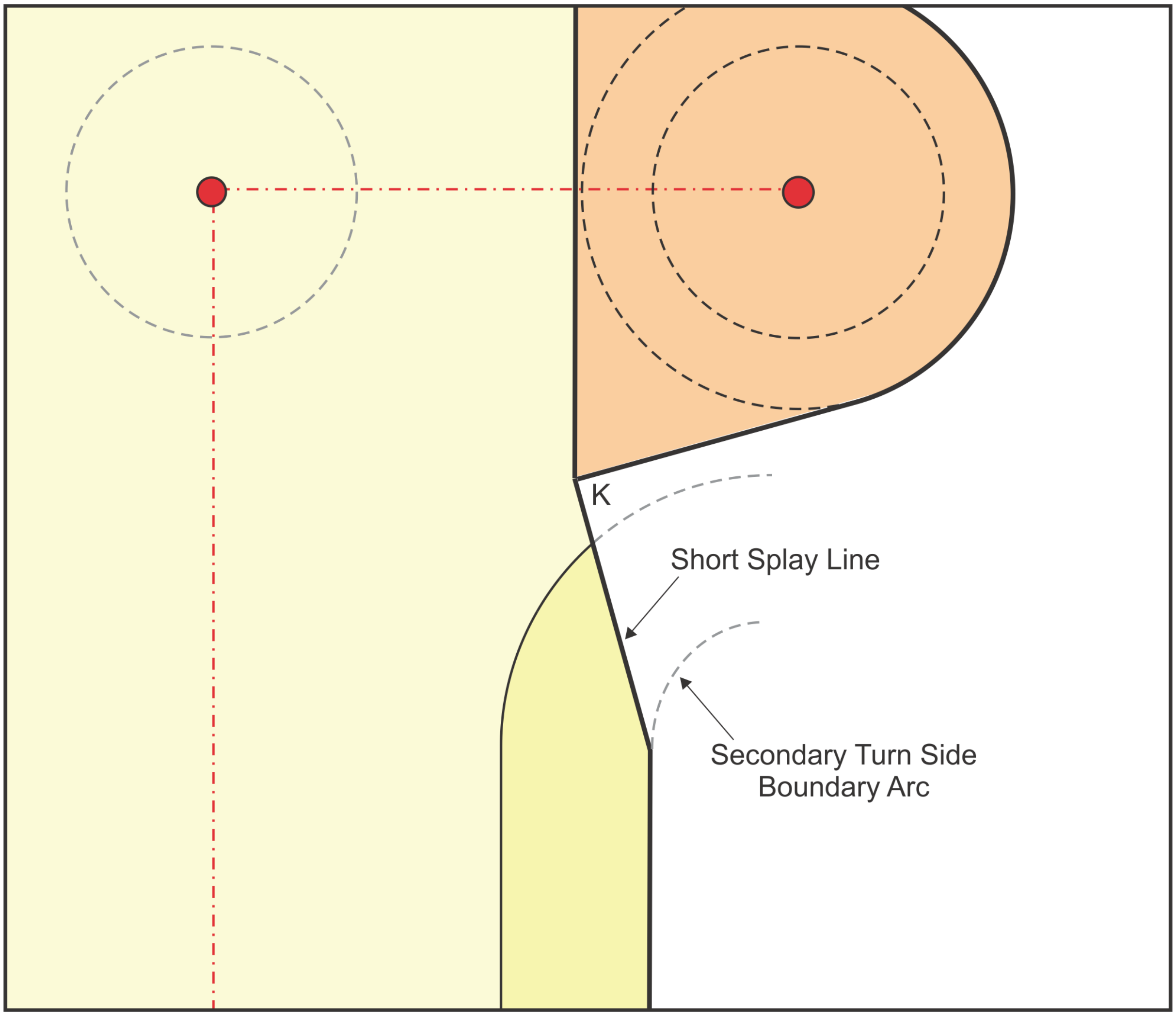
Figure 6-16. Construction of the Turn Side Boundary, Case 2b



Step 12c: If full width cannot be achieved in the initial segment [as described in Step 12a], and a tangent line cannot be drawn between Point K and the Secondary Turn Side Boundary Arc [as described in Step 12b(1)(a)],

Step 12c (1): Construct the Short Splay Line as a line that starts at Point K and ends at the end of the Secondary Turn Side Boundary Arc (see Figure 6-9).

Figure 6-17. Construction of the Turn Side Boundary, Case 3 Determination



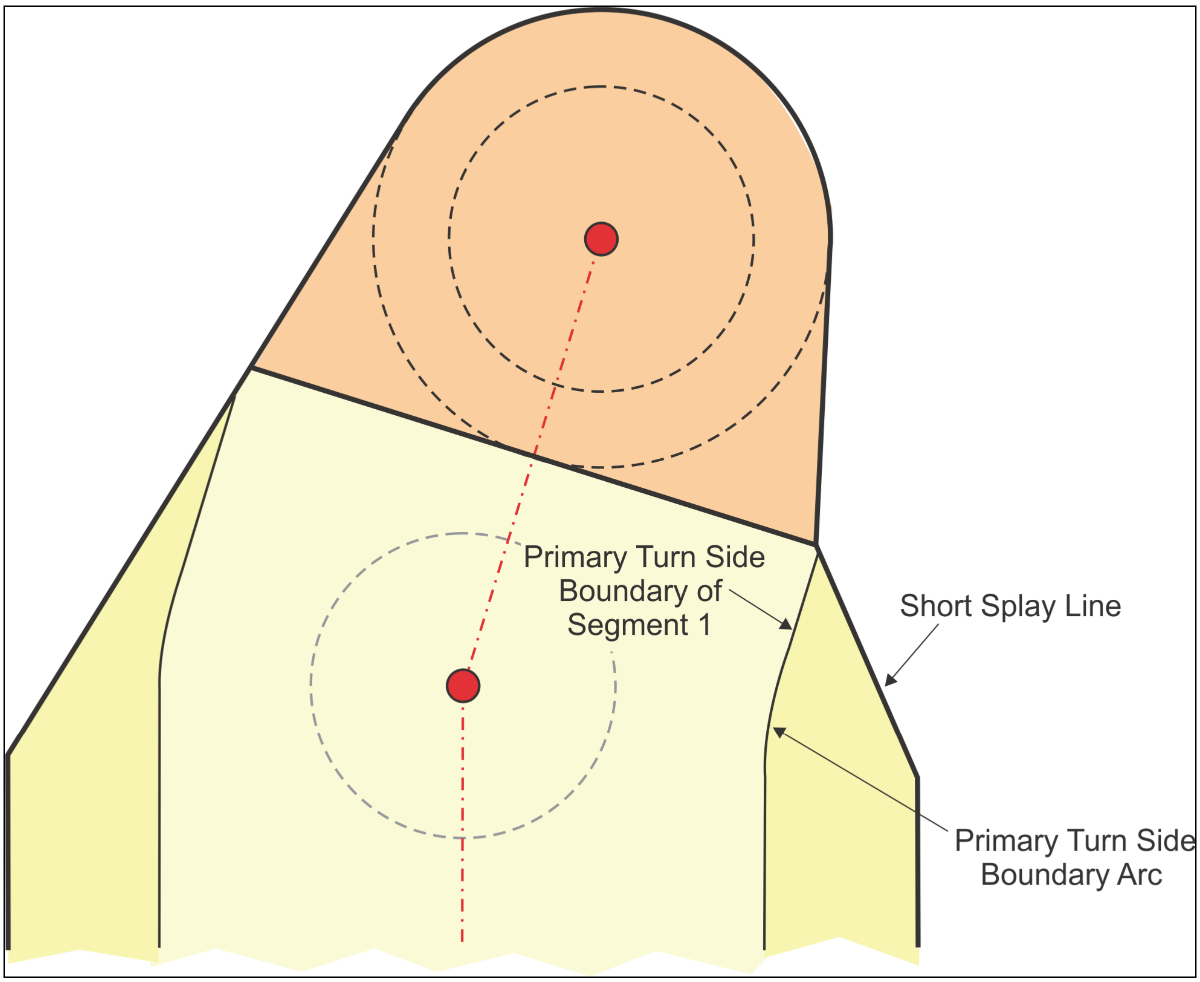
Step 12c (2): If the Short Splay Line intersects the Primary Turn Side Boundary of Segment 1 (see Figure 6-18) then,

Step 12c (2)(a): Remove the Secondary Turn Side Boundary of Segment 1,

Step 12c (2)(b): Remove the Secondary Turn Side Boundary Arc, and

Step 12c (2)(c): Truncate the Primary Turn Side Boundary of Segment 1 at its intersection with the Short Splay Line.

Figure 6-18. Construction of the Turn Side Boundary, Case 3a



Step 12c (3): If the Short Splay Line intersects the Primary Turn Side Boundary Arc (see Figure 6-19) then,

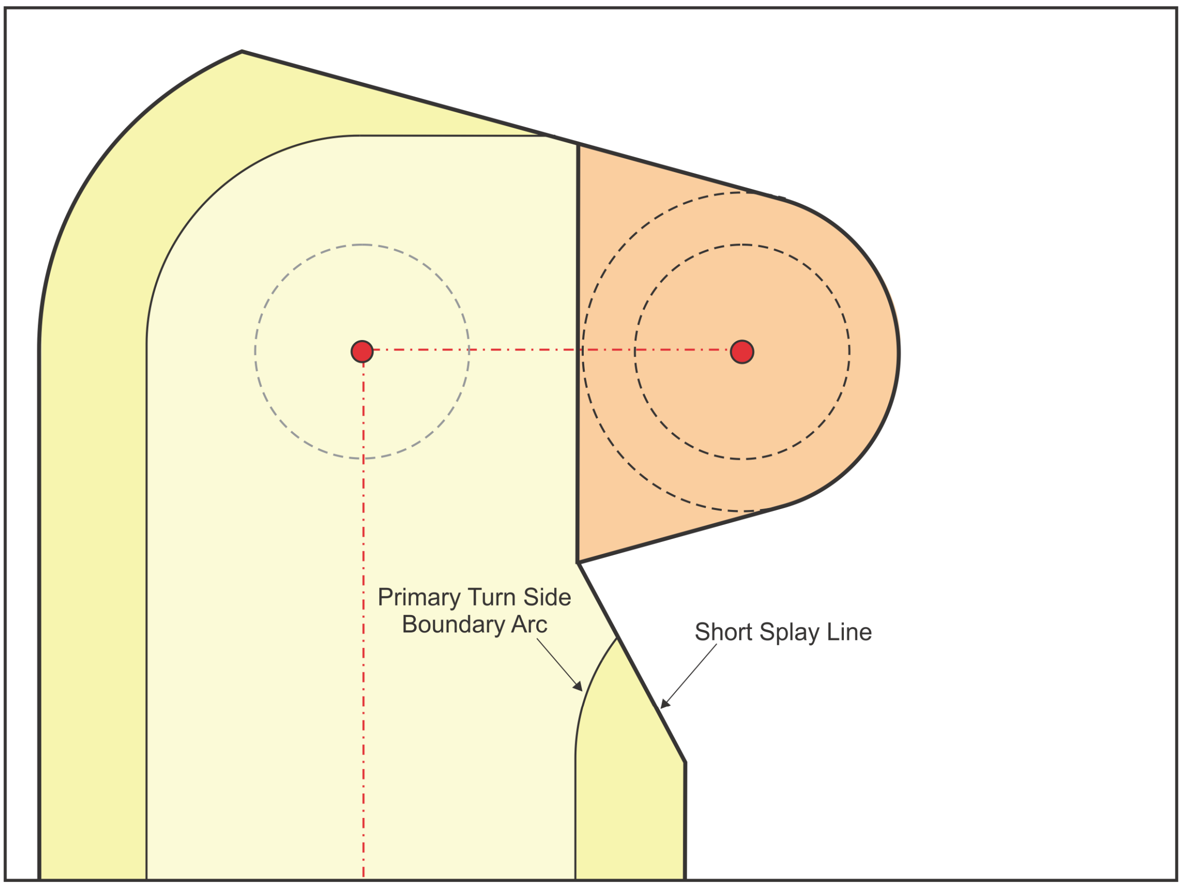
Step 12c (3)(a): Remove the Primary Turn Side Boundary of Segment 1,

Step 12c (3)(b): Remove the Secondary Turn Side Boundary of Segment 1,

Step 12c (3)(c): Remove the Secondary Turn Side Boundary Arc, and

Step 12c (3)(d): Truncate the Primary Turn Side Boundary Arc at its point of intersection with the Short Splay Line.

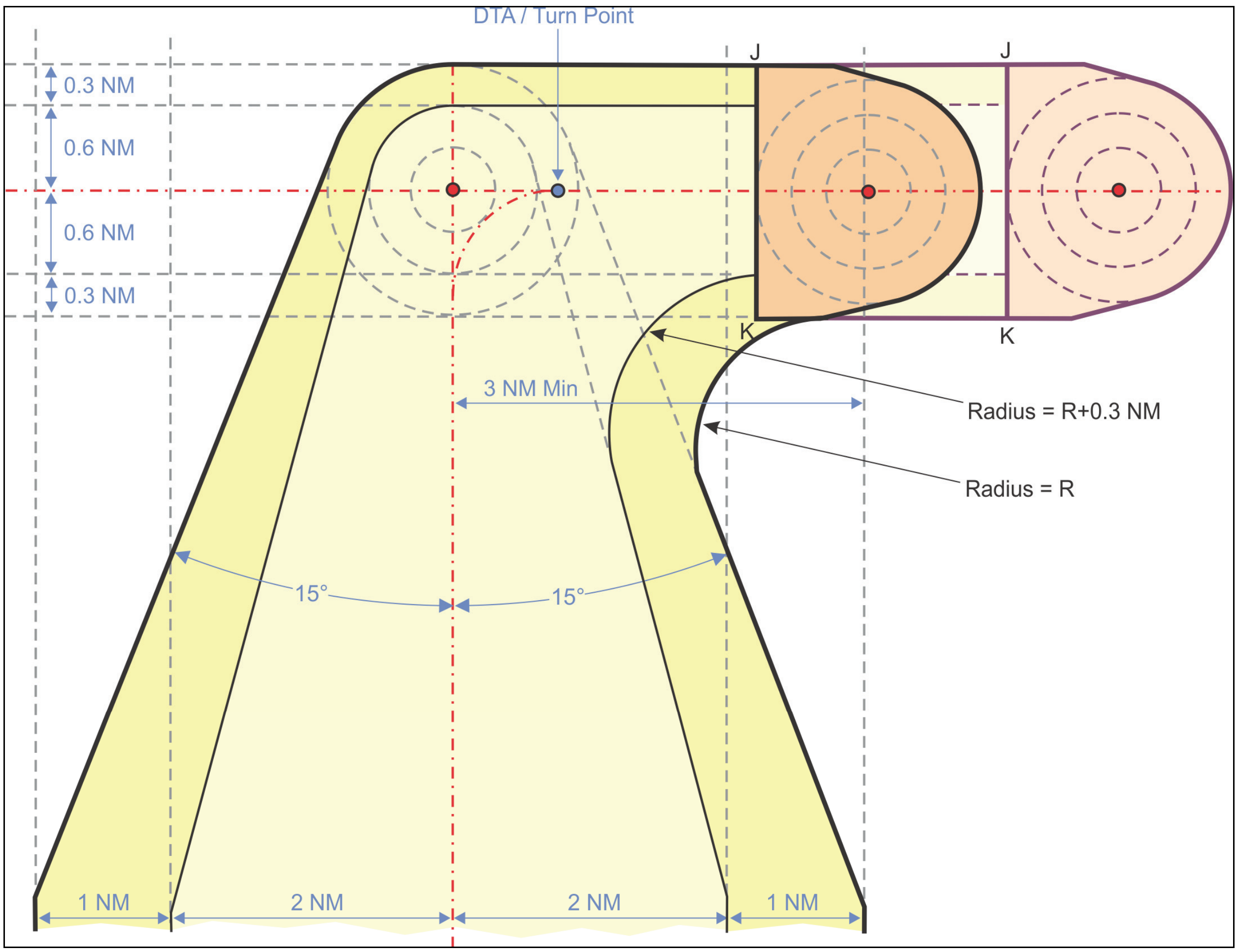
Figure 6-19. Construction of the Turn Side Boundary, Case 3b



6-7. Special PinS Departure Construction. When necessary to avoid obstacles, a Special DP may be constructed where the initial departure leg (only) is designed with an ATT value of 0.3 NM (RNP/RNAV 0.3).

For this construction, multiple OEA configurations can occur that are greatly affected by the course change angle and the length of the first departure segment. Some examples of these different scenarios are illustrated in Figure 6-20. Instructions on how to define these cases and create the resulting OEAs are located in this paragraph.

Figure 6-20. Special OEA Area Plan View (90 Degree Turn)



Step 1: Position the IDF as an FB fix. Use a fix-to-fix distance that is in accordance with chapter 2, paragraph 2b.

Step 2: Construct the IDF Circle as an arc with a 0.8 NM radius centered at the IDF fix.

Step 3: Construct the Designed Turning Flight Path.

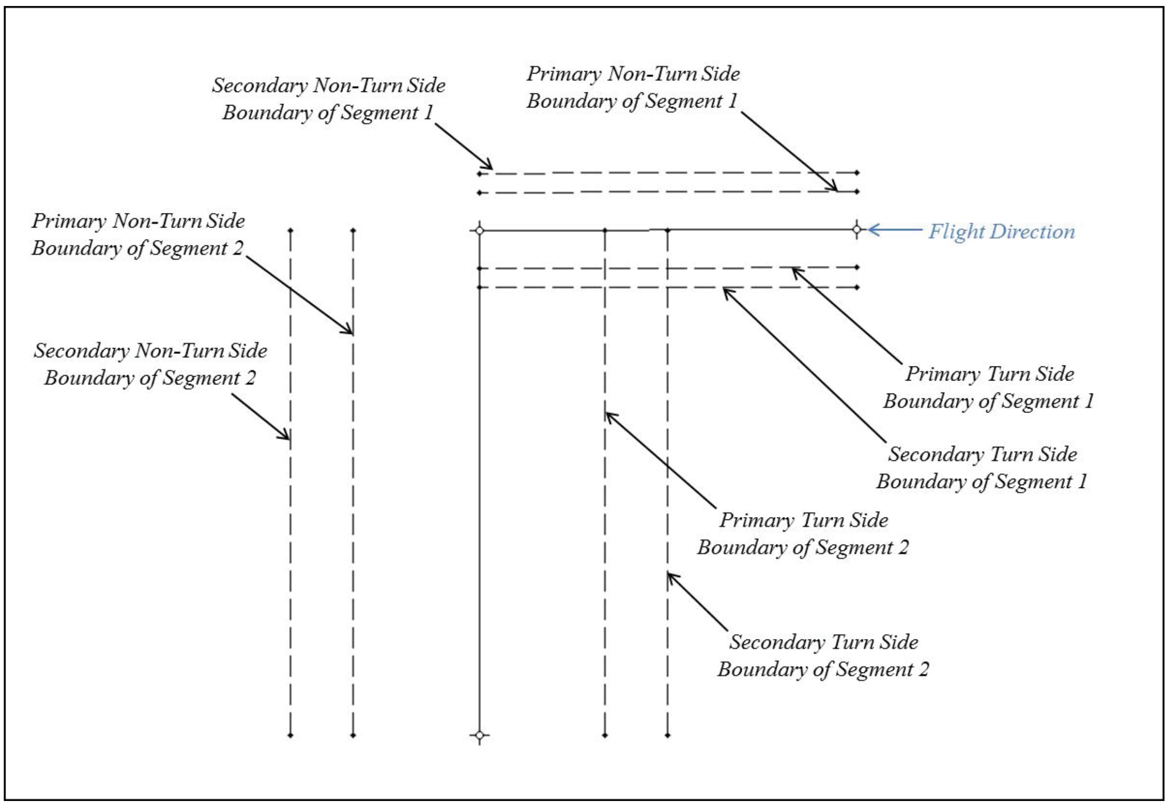
Step 3a: Determine the turn radius (R) utilizing Formula 6-1.

Step 3b: Construct an arc of radius R starting at the early turn point that lays tangent to Segments 1 and 2.

Step 4: Construct Segment 1 Boundaries. Construct Boundaries of half-widths 0.3-0.6-0.6-0.3 in reference to Segment 1. They will hereby be referred to as the Secondary Turn Side Boundary of Segment 1, the Primary Turn Side Boundary of Segment 1, the Primary Non-Turn Side Boundary of Segment 1, and the Secondary Non-Turn Side Boundary of Segment 1. These boundaries are depicted in Figure 6-21.

Step 5: Construct Segment 2 Boundaries. Construct Boundaries of half-widths 1-2-2-1 in reference to Segment 2. They will hereby be referred to as the Secondary Turn Side Boundary of Segment 2, the Primary Turn Side Boundary of Segment 2, the Primary Non-Turn Side Boundary of Segment 2, and the Secondary Non-Turn Side Boundary of Segment 2. These boundaries are depicted in Figure 6-21.

Figure 6-21. Construction of the Segment 1 and Segment 2 Boundaries



Step 6: Construct the Segment 1 Turn Side Splay Line (see Figure 6-22).

Step 6a: Locate the Segment 1 Splay End Reference Point a distance of 0.1/tan(15°) NM from the IDF along the Segment 1 Course Line.

Step 6b: Locate the Segment 1 Turn Side Splay Line End Point as the Segment 1 Splay End Reference Point projected onto the Secondary Turn Side Boundary of Segment 1.

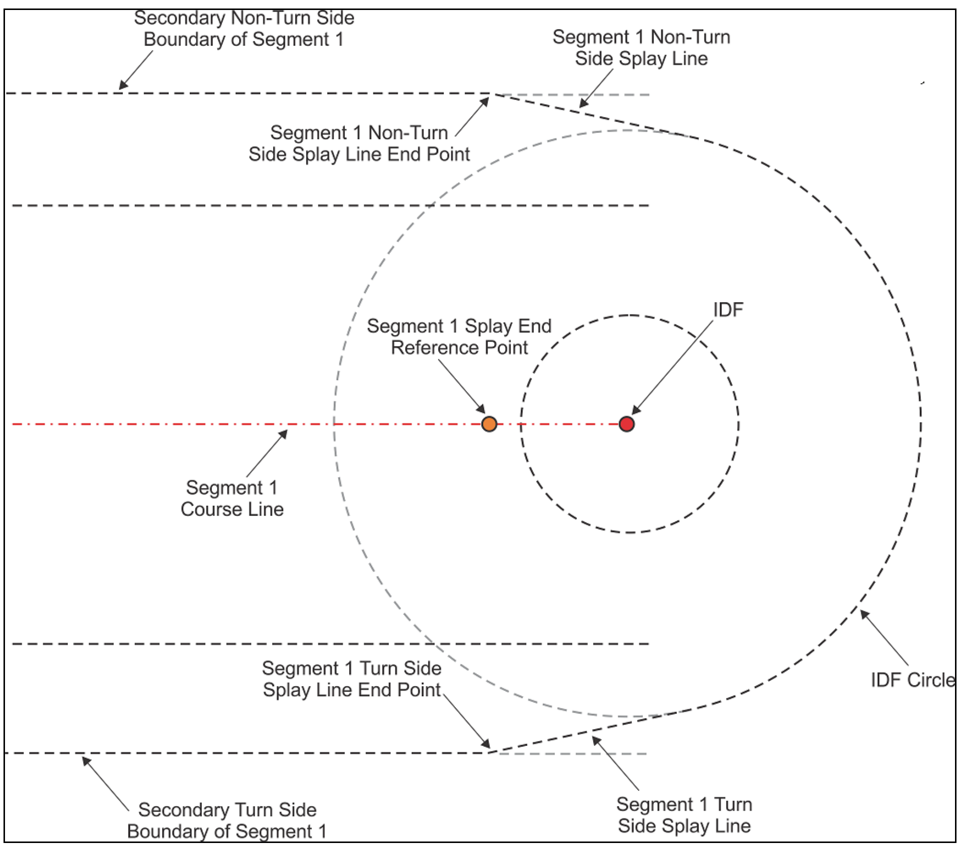
Step 6c: Construct the Segment 1 Turn Side Splay Line as a line that is tangent to the IDF Circle passing through the Segment 1 Turn Side Splay Line End Point.

Step 7: Construct the Segment 1 Non-Turn Side Splay Line (see Figure 6-22).

Step 7a: Locate the Segment 1 Non-Turn Side Splay Line End Point as the Segment 1 Splay End Reference Point projected onto the Secondary Non-Turn Side Boundary of Segment 1.

Step 7b: Construct the Segment 1 Non-Turn Side Splay Line as a line that is tangent to the IDF Circle passing through the Segment 1 Non-Turn Side Splay Line End Point.

Figure 6-22. Construction of the Splay Lines



Step 8: Construct the IDF Flat Surface Area (see Figure 6-23).

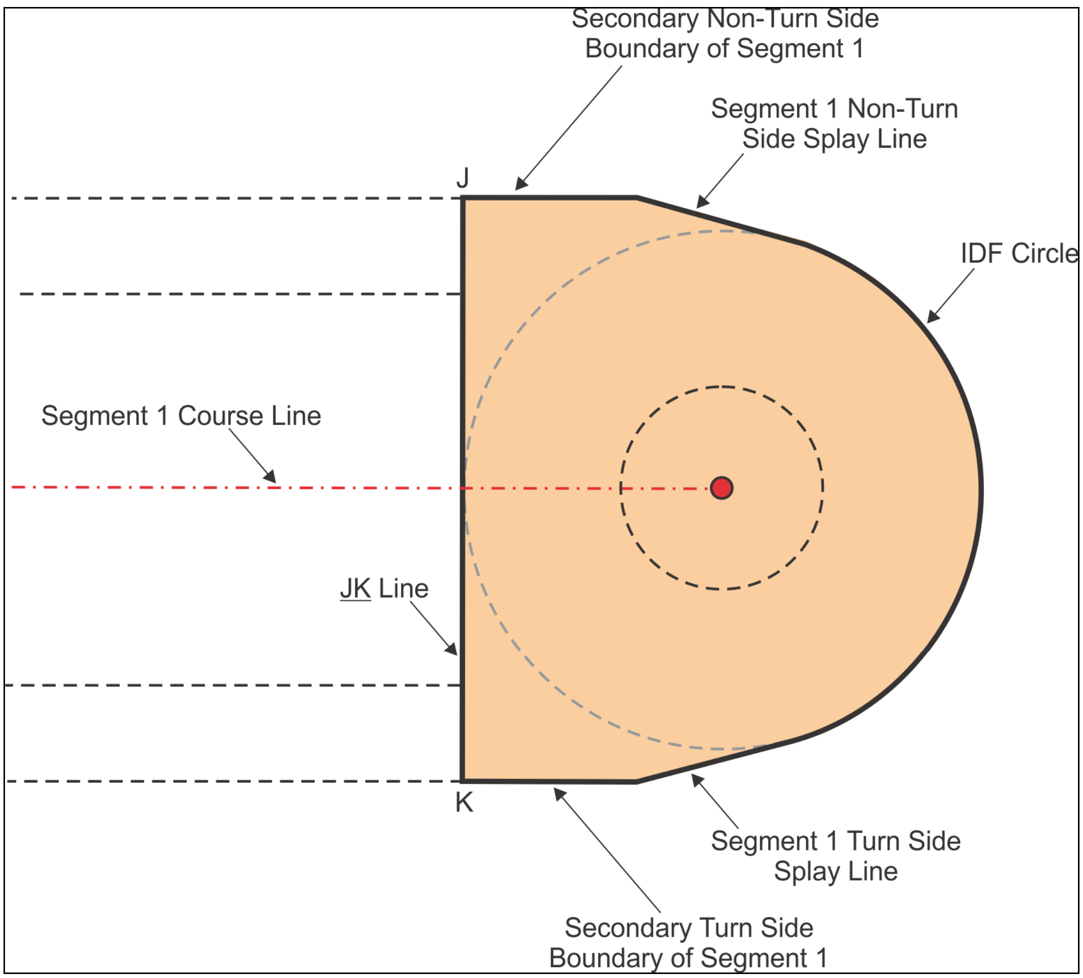
Step 8a: Construct the JK line as a line that lays tangent to the IDF Circle at a point intersecting the Segment 1 Course Line.

Step 8b: Truncate the JK line where it intersects the Secondary Non-Turn Side Boundary of Segment 1 and the Secondary Turn Side Boundary of Segment 1.

Step 8c: The IDF Flat Surface Area is the area bounded by the IDF Circle, the Segment 1 Turn Side and Non-Turn Side Splay Lines, the Secondary Turn Side and Non-Turn Side Boundaries of Segment 1, and the JK line.

Step 8d: The Turn Side end of the JK line will hereby be referred to as Point K and the Non-Turn Side end of the JK line will hereby be referred to as Point J.

Figure 6-23. Construction of the IDF Flat Surface Area

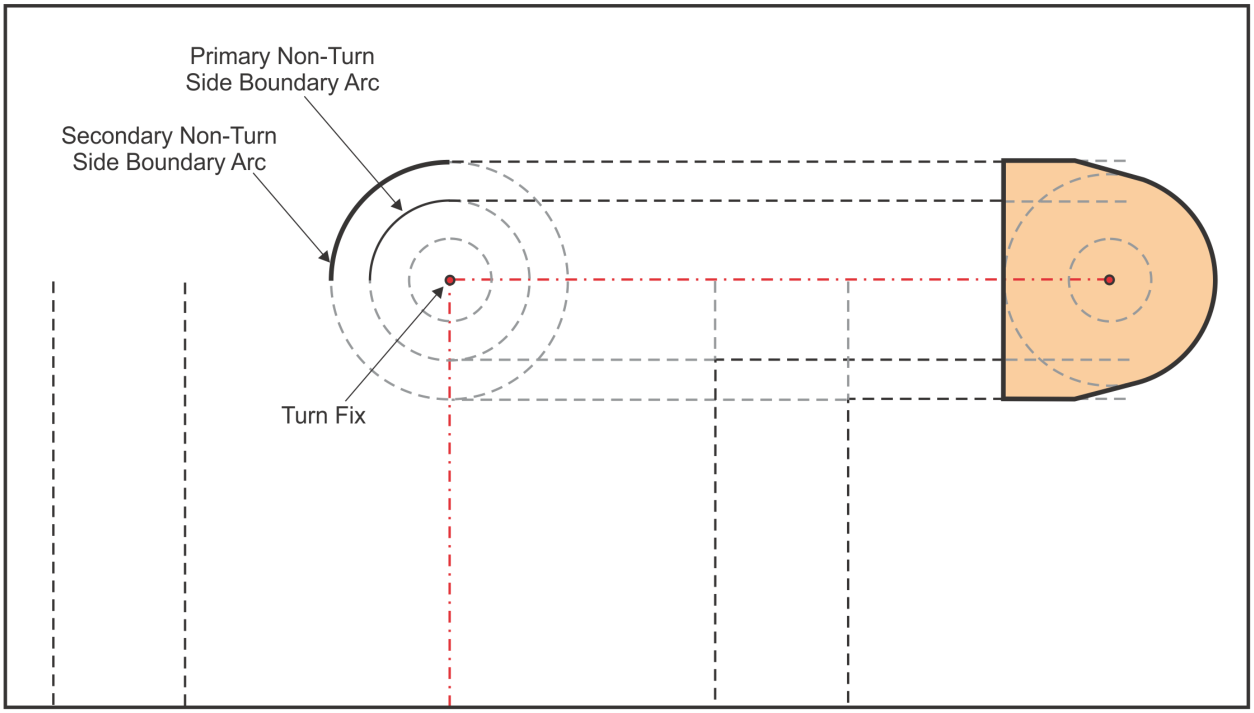


Step 9: Construct Non-Turn Side Boundary Arcs (see Figure 6-24).

Step 9a: Construct the Primary Non-Turn Side Boundary Arc centered on the turn fix with a radius equal to the Segment 1 primary half-width.

Step 9b: Construct the Secondary Non-Turn Side Boundary Arc centered on the turn fix with a radius equal to the Segment 1 primary half-width plus the segment secondary width.

Figure 6-24, Construction of the Non-Turn Side Boundary Arcs



Step 10: Construct Segment 2 Splay Lines.

Step 10a: Construct Segment 2 Secondary Non-Turn Side Splay Line (see Figure 6-25).

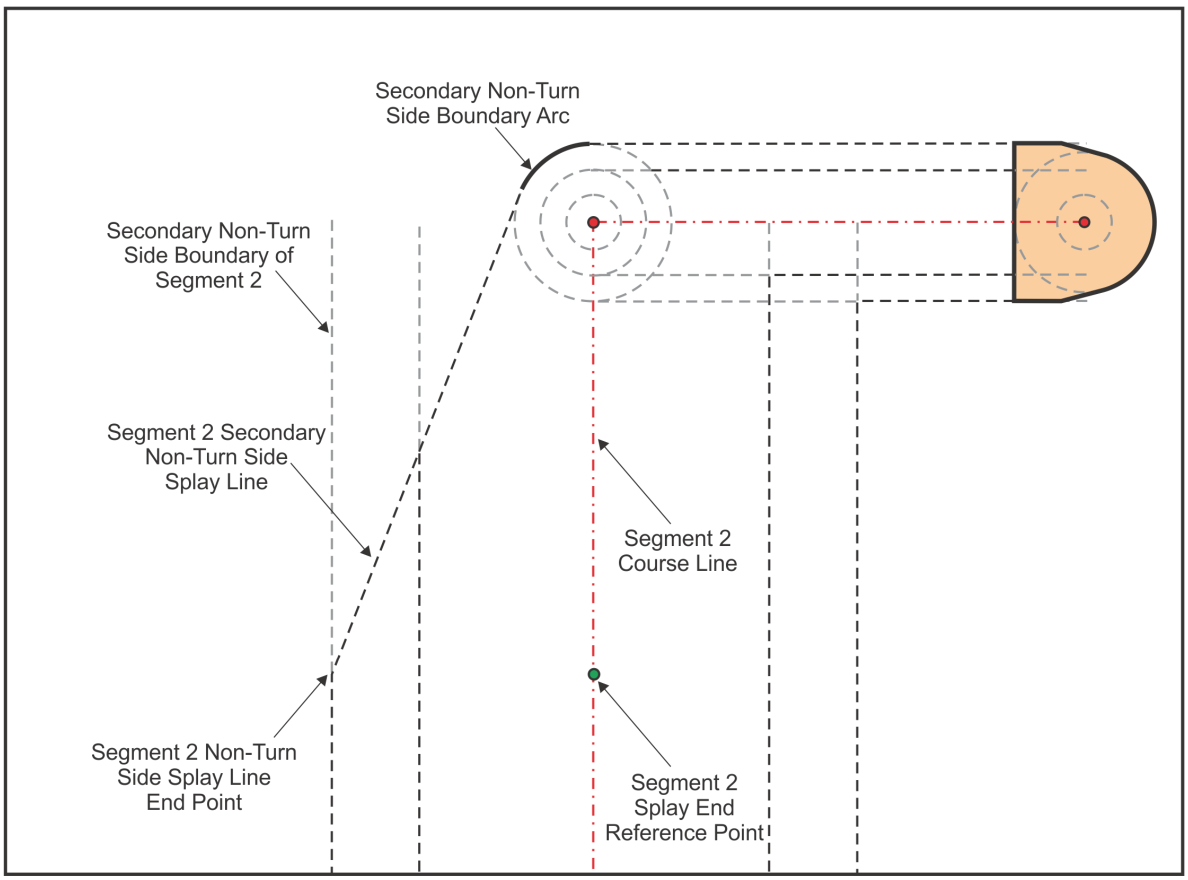
Step 10a (1): Locate the Segment 2 Splay End Reference Point a distance of 2.1/tan(15°) NM from the turn fix along the Segment 2 Course Line.

Step 10a (2): Locate the Segment 2 Non-Turn Side Splay Line End Point as the Segment 2 Splay End Reference Point projected onto the Secondary Non-Turn Side Boundary of Segment 2.

Step 10a (3): Construct the Segment 2 Secondary Non-Turn Side Splay Line as a line that is tangent to the Secondary Non-Turn Side Boundary Arc passing through the Segment 2 Non-Turn Side Splay Line End Point.

Step 10a (4): If Segment 2 is not long enough to allow for a full expansion with a 15-degree splay, utilize a splay angle ≥ 15 degrees as necessary to reach full expansion at the termination of Segment 2.

Figure 6-25. Construction of the Segment 2 Secondary Non-Turn Side Splay Line



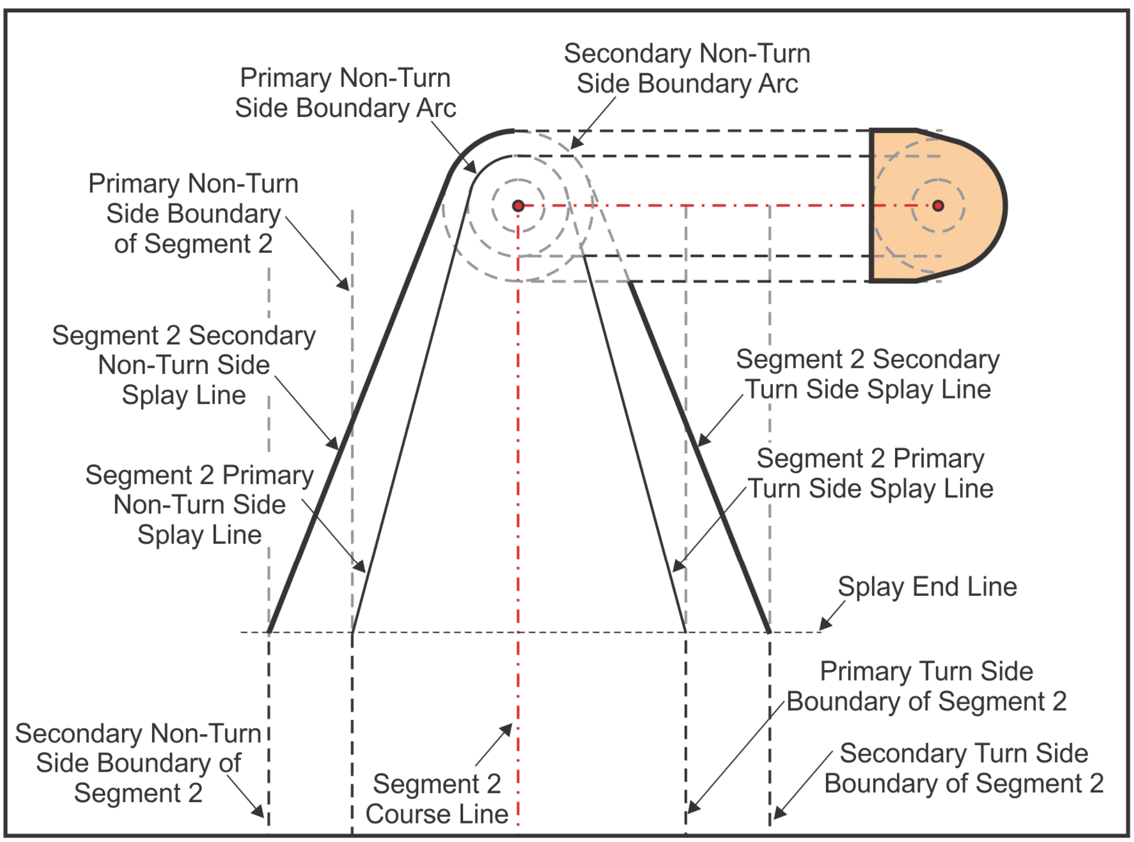
Step 10b: Construct the Splay End Line as an infinite line that is perpendicular to the Segment 2 Course Line and intersects at the end point of the Segment 2 Secondary Non-Turn Side Splay Line. The Splay End Line will be used to determine the end points of the remaining Segment 2 splay lines (see Figure 6-26).

Step 10c: Construct the Segment 2 Primary Non-Turn Side Splay Line as a line tangent to the Primary Non-Turn Side Boundary Arc and runs through the intersection of the Splay End Line and the Primary Non-Turn Side Boundary of Segment 2 (see Figure 6-26).

Step 10d: Construct the Segment 2 Primary Turn Side Splay Line as a line tangent to the Primary Non-Turn Side Boundary Arc and runs through the intersection of the Splay End Line and the Primary Turn Side Boundary of Segment 2 (see Figure 6-26).

Step 10e: Construct the Segment 2 Secondary Turn Side Splay Line as a line tangent to the Secondary Non-Turn Side Boundary Arc and runs through the intersection of the Splay End Line and the Secondary Turn Side Boundary of Segment 2 (see Figure 6-26).

Figure 6-26. Construction of the Segment 2 Splay Lines



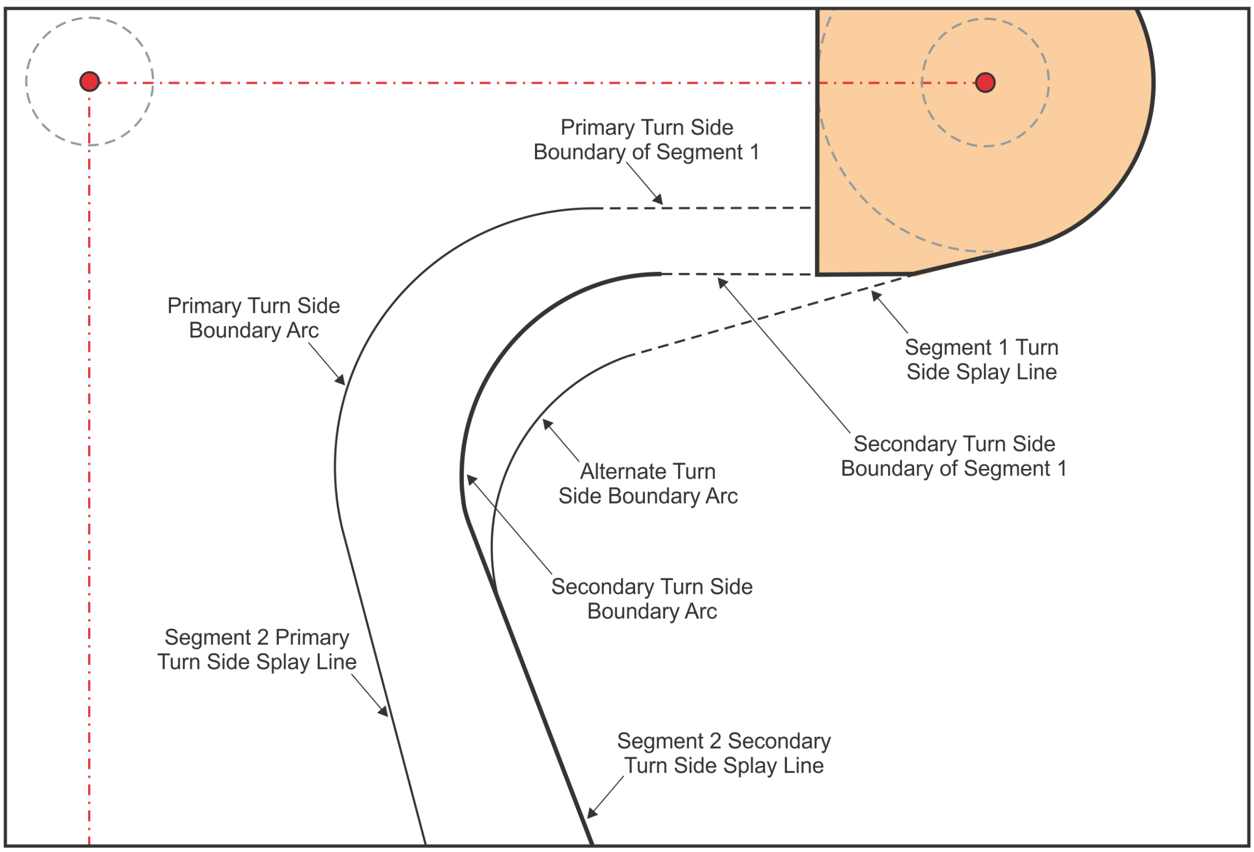
Step 11: Construct Turn Side Boundary Arcs (see Figure 6-27).

Step 11a: Construct the Primary Turn Side Boundary Arc as an arc that is tangent to both the Segment 2 Primary Turn Side Splay Line and the Primary Turn Side Boundary of Segment 1 with a radius equal to R + 0.3 NM.

Step 11b: Construct the Secondary Turn Side Boundary Arc an arc that is tangent to both the Segment 2 Secondary Turn Side Splay Line and the Secondary Turn Side Boundary of Segment 1 with a radius equal to R.

Step 11c: Construct the Alternate Turn Side Boundary Arc as an arc that is tangent to both the Segment 2 Secondary Turn Side Splay Line and the Segment 1 Turn Side Splay Line with a radius equal to R.

Figure 6-27. Construction of the Turn Side Boundary Arcs

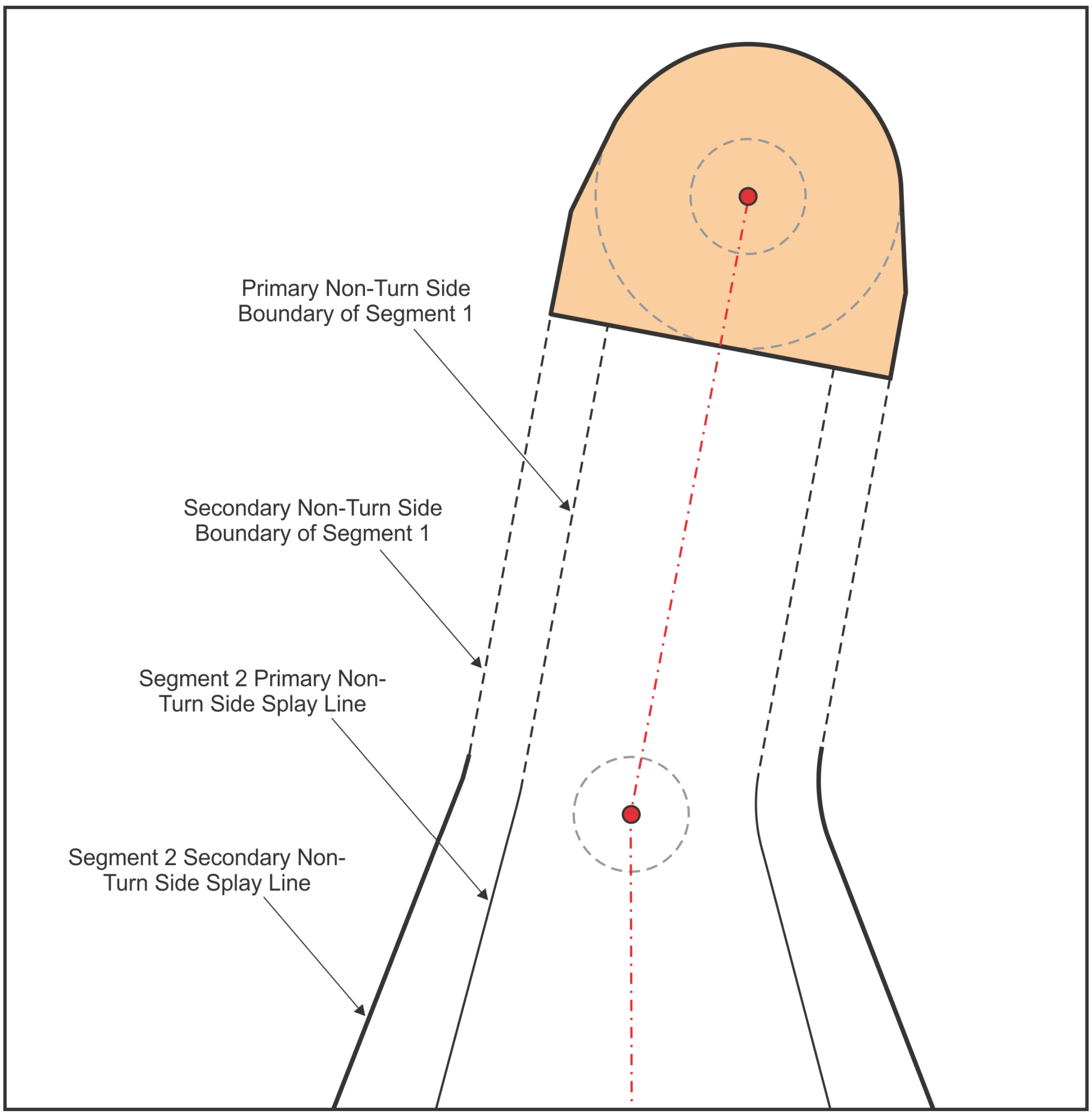


Step 12: Define and Construct the Secondary Non-Turn Side Boundary.

Step 12a: If the Secondary Non-Turn Side Boundary of Segment 1 intersects the Segment 2 Secondary Non-Turn Side Splay Line, as depicted in Figure 6-28, then remove the Secondary Non-Turn Side Boundary Arc and truncate the Secondary Non-Turn Side Boundary of Segment 1 and the Segment 2 Secondary Non-Turn Side Splay Line at their intersection.

Step 12b: Otherwise, truncate the Secondary Non-Turn Side Boundary of Segment 1 and the Segment 2 Secondary Non-Turn Side Splay Line at their point of tangency with the Secondary Non-Turn Side Boundary Arc (see Figure 6-29).

Figure 6-28. Construction of the Non-Turn Side Boundary, Case 1

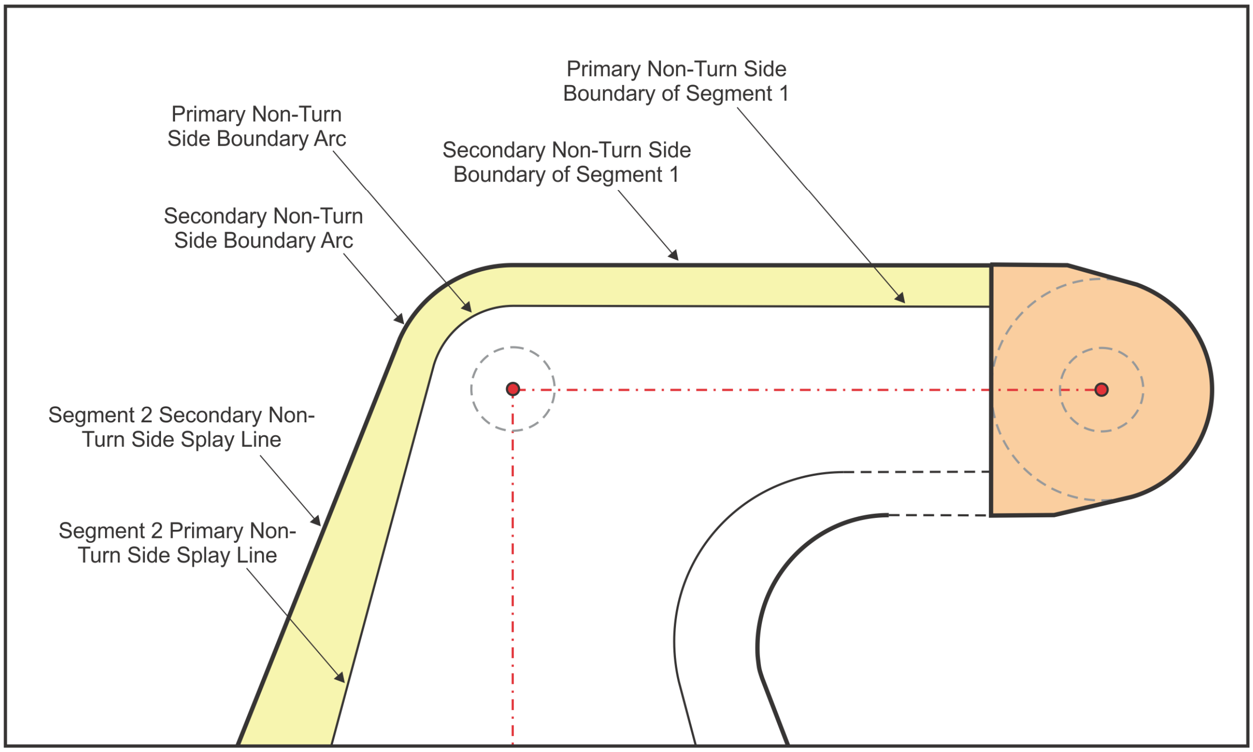


Step 13: Define and Construct the Primary Non-Turn Side Boundary.

Step 13a: If the Primary Non-Turn Side Boundary of Segment 1 intersects the Segment 2 Primary Non-Turn Side Splay Line, as depicted in Figure 6-28, then remove the Primary Non-Turn Side Boundary Arc and truncate the Primary Non-Turn Side Boundary of Segment 1 and the Segment 2 Primary Non-Turn Side Splay Line at their intersection.

Step 13b: Otherwise, truncate the Primary Non-Turn Side Boundary of Segment 1 and the Segment 2 Primary Non-Turn Side Splay Line at their point of tangency with the Primary Non-Turn Side Boundary Arc (see Figure 6-29).

Figure 6-29. Construction of the Non-Turn Side Boundary, Case 2



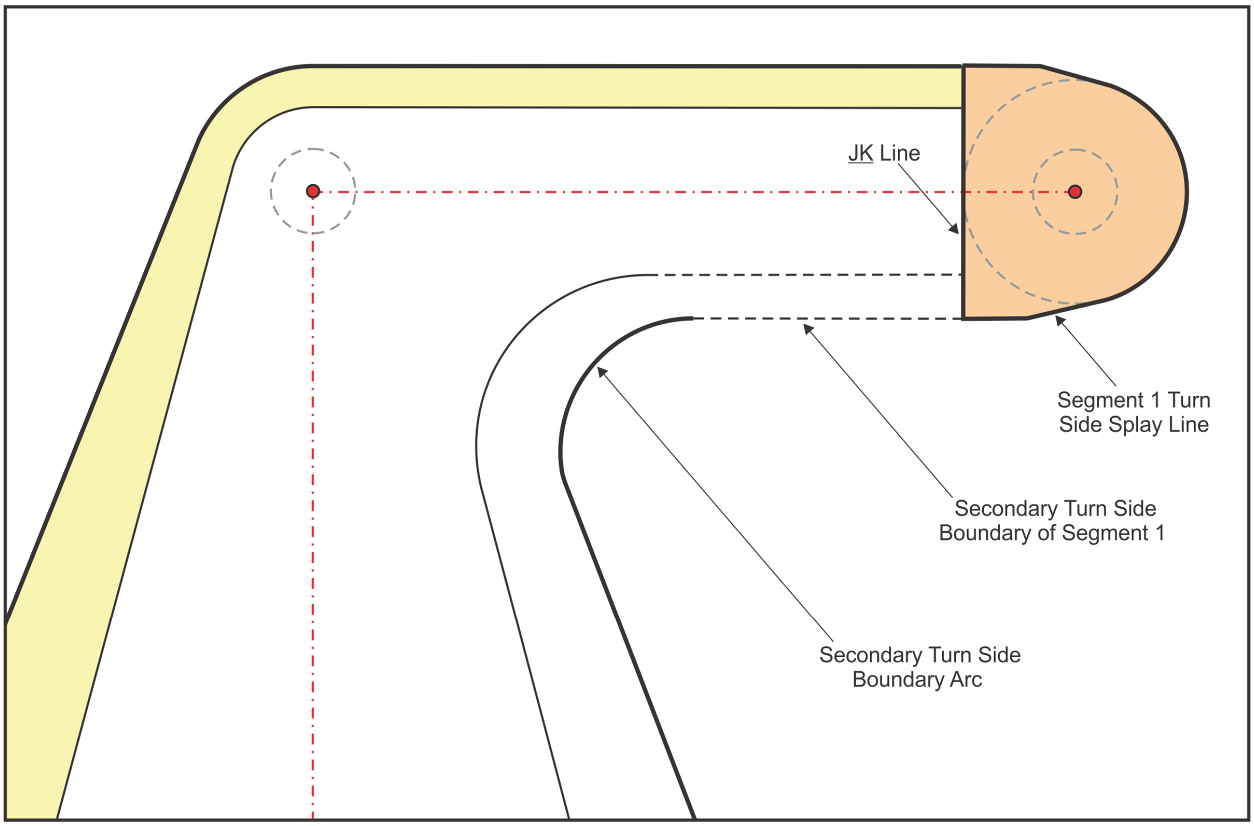
Step 14: Define and Construct the Secondary Turn Side Boundary

Step 14a: If the intersection of the Secondary Turn Side Boundary of Segment 1 and the Segment 1 Turn Side Splay Line occurs before the start of the Secondary Turn Side Boundary Arc (see Figure 6-30) then,

Step 14a (1): Remove the Alternate Turn Side Boundary Arc, and

Step 14a (2): Truncate the Secondary Turn Side Boundary of Segment 1 where it intersects the JK line.

Figure 6-30. Construction of the Secondary Turn Side Boundary, Case 1



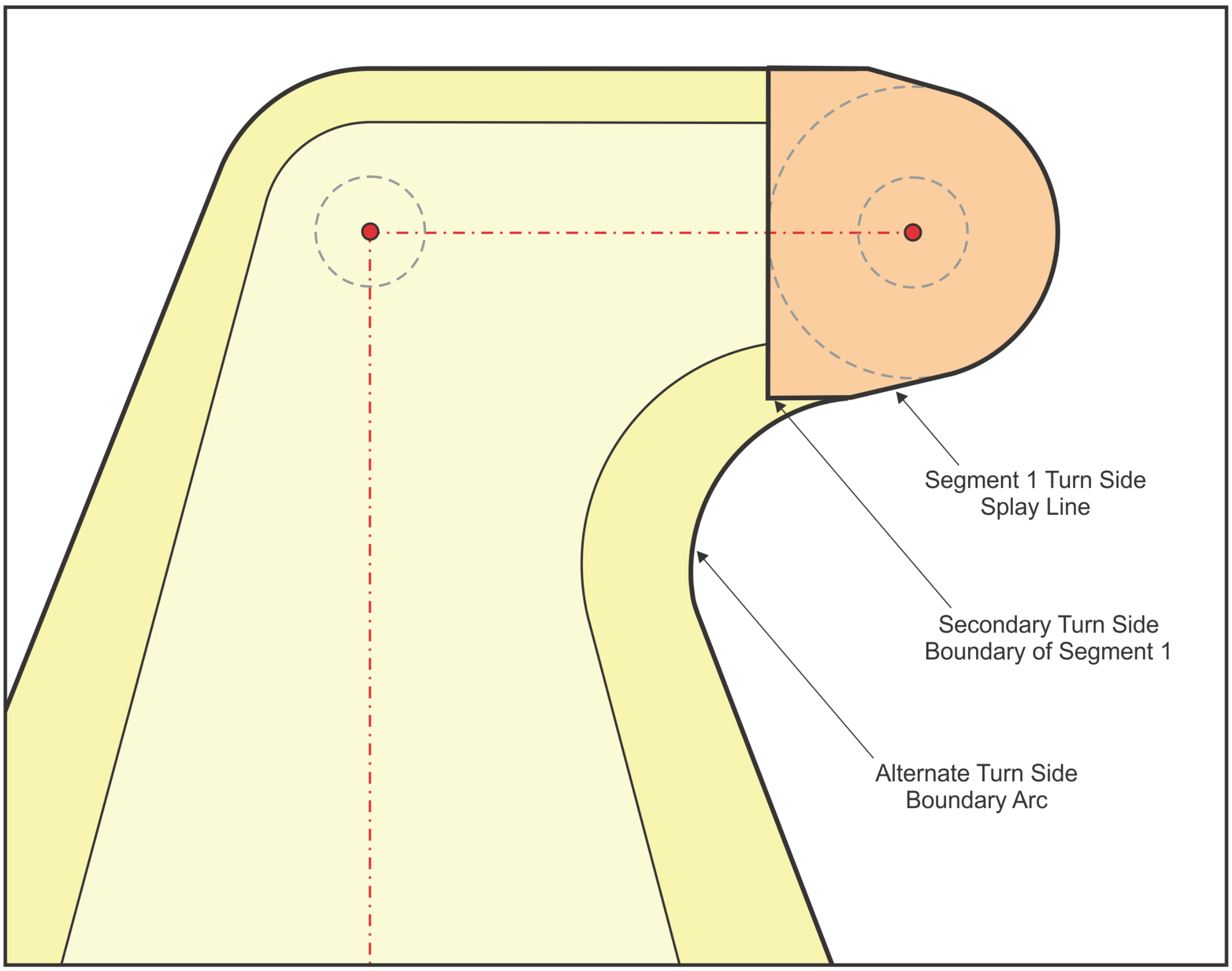
Step 14b: If the intersection of the Secondary Turn Side Boundary of Segment 1 and the Segment 1 Turn Side Splay Line occurs after the start of the Secondary Turn Side Boundary Arc (see Figure 6-31) then,

Step 14b (1): Remove the Secondary Turn Side Boundary Arc,

Step 14b (2): Remove the Secondary Turn Side Boundary of Segment 1, and

Step 14b (3): Extend the Segment 1 Turn Side Splay Line to the Alternate Turn Side Boundary Arc.

Figure 6-31. Construction of the Secondary Turn Side Boundary, Case 2

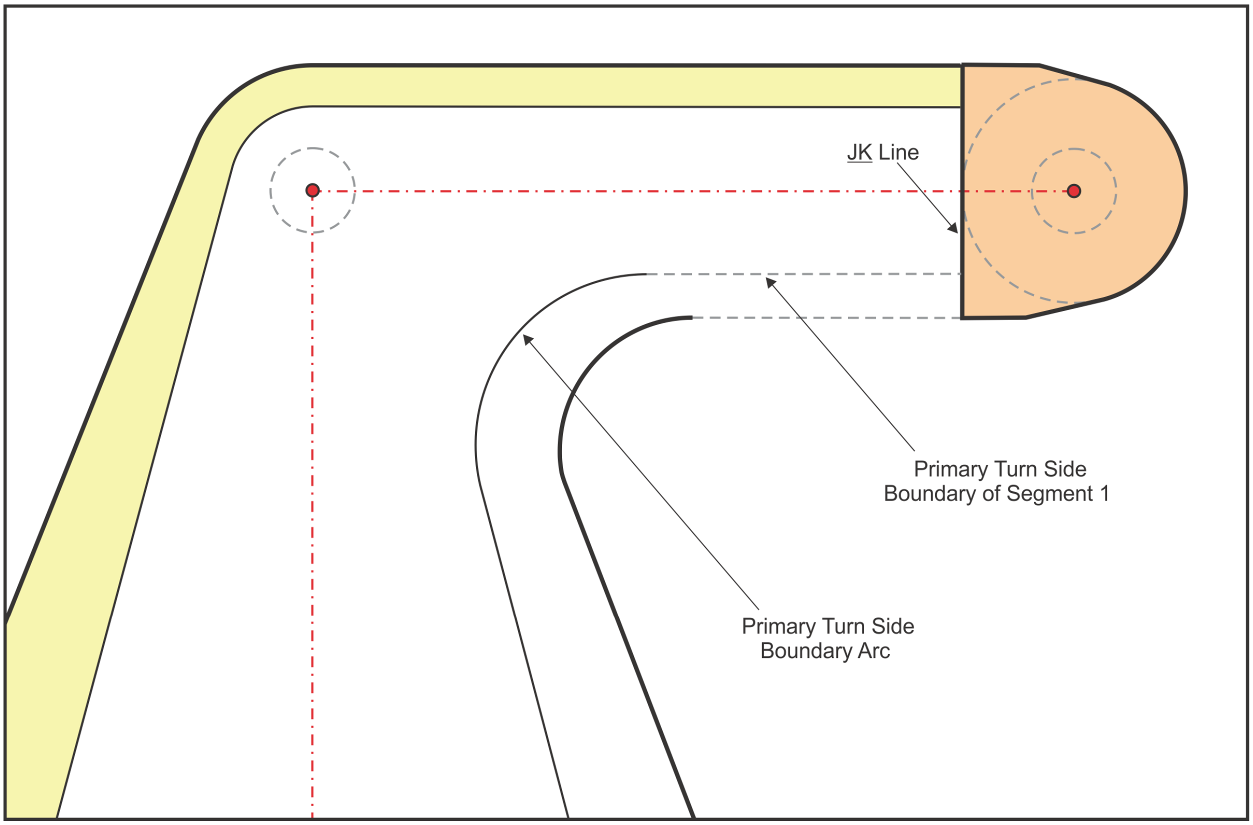


Step 15: Define and Construct the Primary Turn Side Boundary

Step 15a: If the JK line intersects the Primary Turn Side Boundary of Segment 1 (see Figure 6-32) then,

Step 15a (1): Truncate the Primary Turn Side Boundary of Segment 1 where it intersects the JK line.

Figure 6-32. Construction of the Primary Turn Side Boundary, Case 1

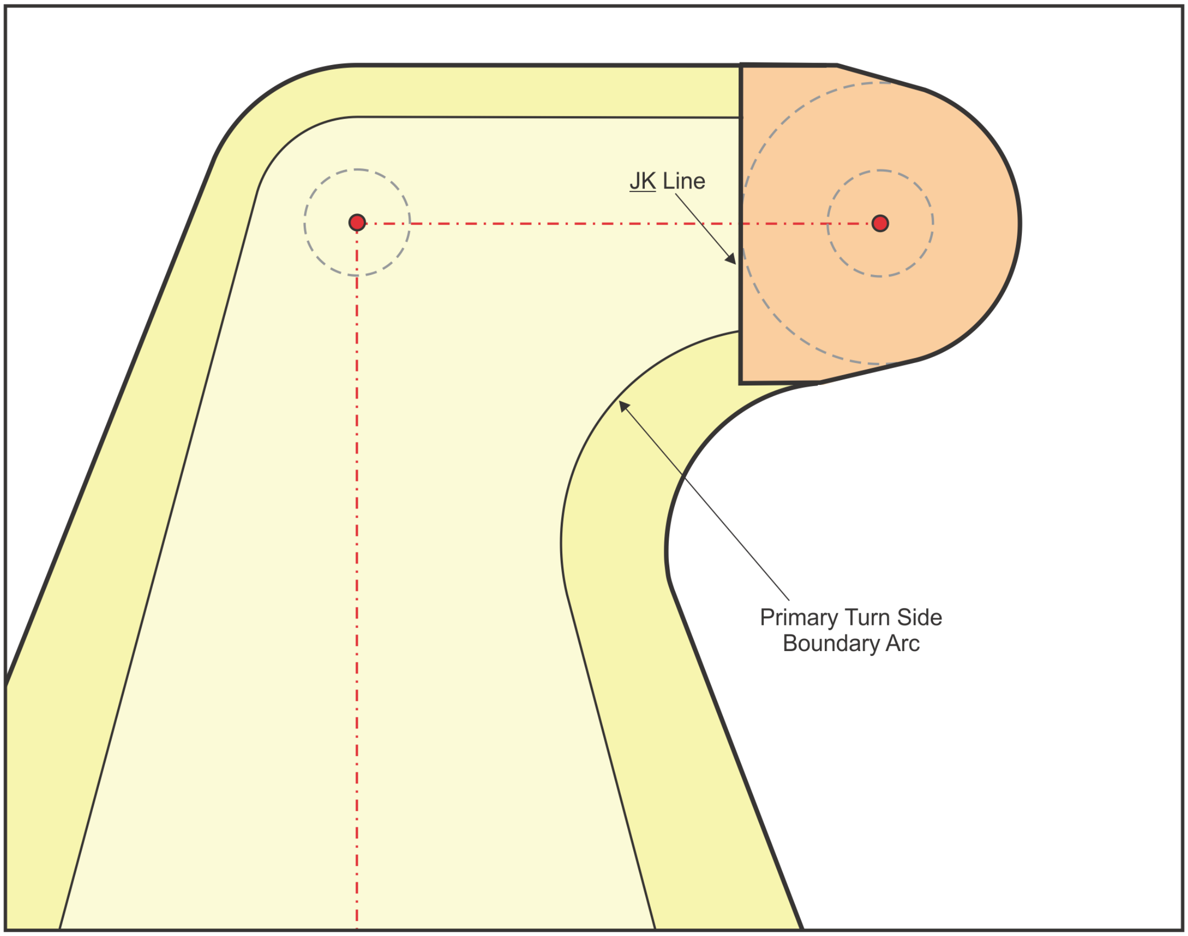


Step 15b: If the JK line intersects the Primary Turn Side Boundary Arc (see Figure 6-33) then,

Step 15b (1): Remove the Primary Turn Side Boundary of Segment 1, and

Step 15b (2): Truncate the Primary Turn Side Boundary Arc where it intersects the JK line.

Figure 6-33. Construction of the Primary Turn Side Boundary, Case 2



6-8. Obstacle Evaluation (OE). Starting at the JK line, apply a 20:1 OCS in the primary OEA, and a 6:1 OCS in the secondary OEA rising perpendicular from the edge of the primary area. Where an obstacle penetrates the primary OCS, or the *secondary OCS throughout the DP, calculate a minimum CG to clear the penetration(s) for all departure segments (legs) or raise the IDF crossing altitude. The highest required CG of all the departure legs is maintained until penetration(s) are cleared, and then the CG may be relaxed. See Figure 6-34 for a Climb Area Profile View and Figure 6-35/Figure 6-36 for a Climb Area Plan View. See paragraph 6-8 for assessing ROC, minimum altitude and CG.

* The elevation of obstacles in the secondary is reduced.

Figure 6-34. Climb Area Profile View

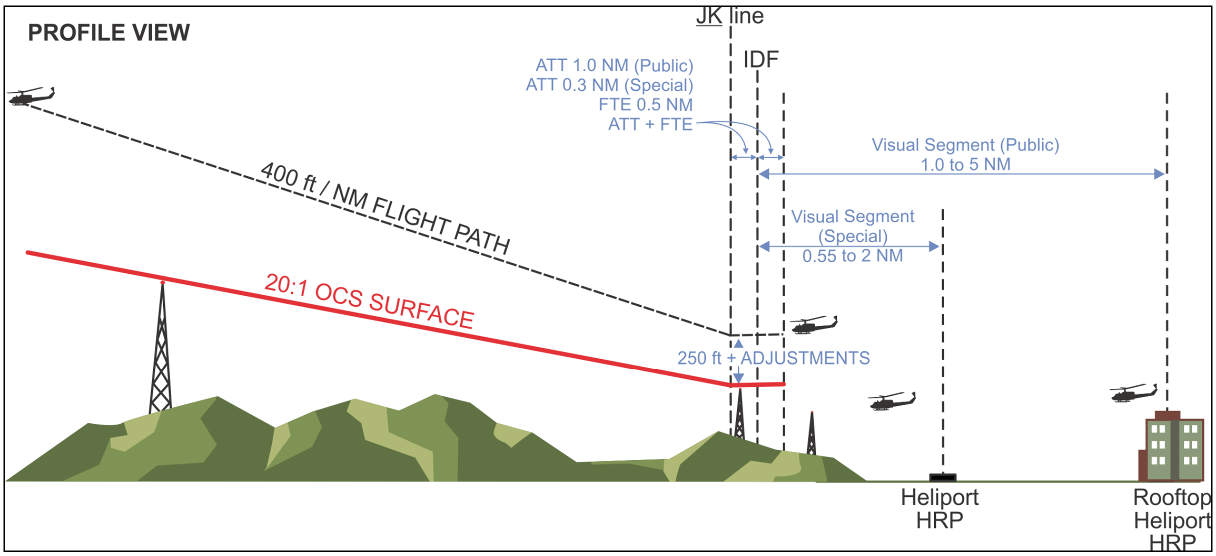


Figure 6-35. Departure Climb Area Plan View (Public)

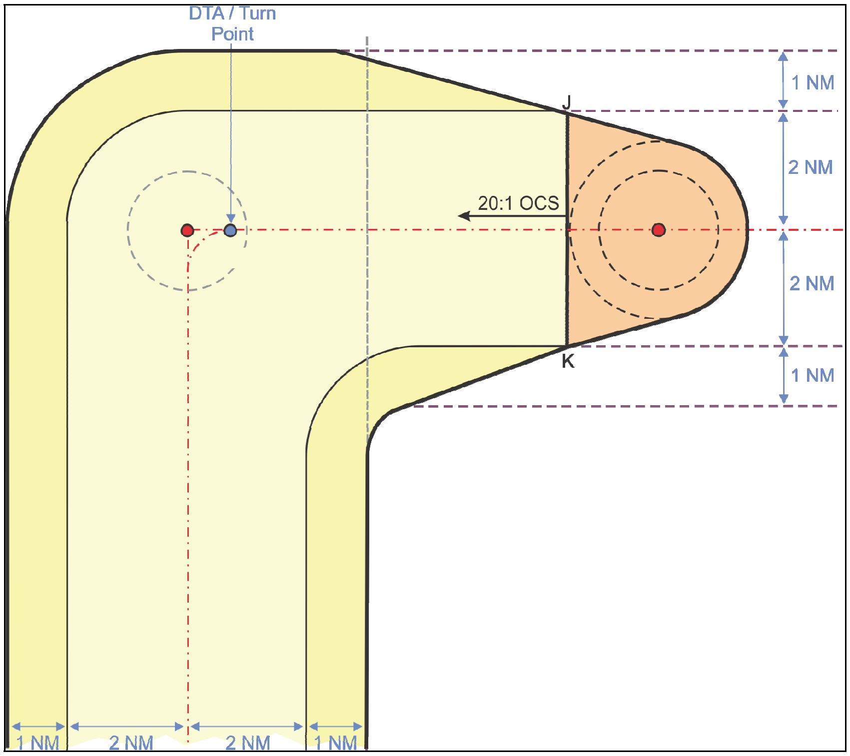
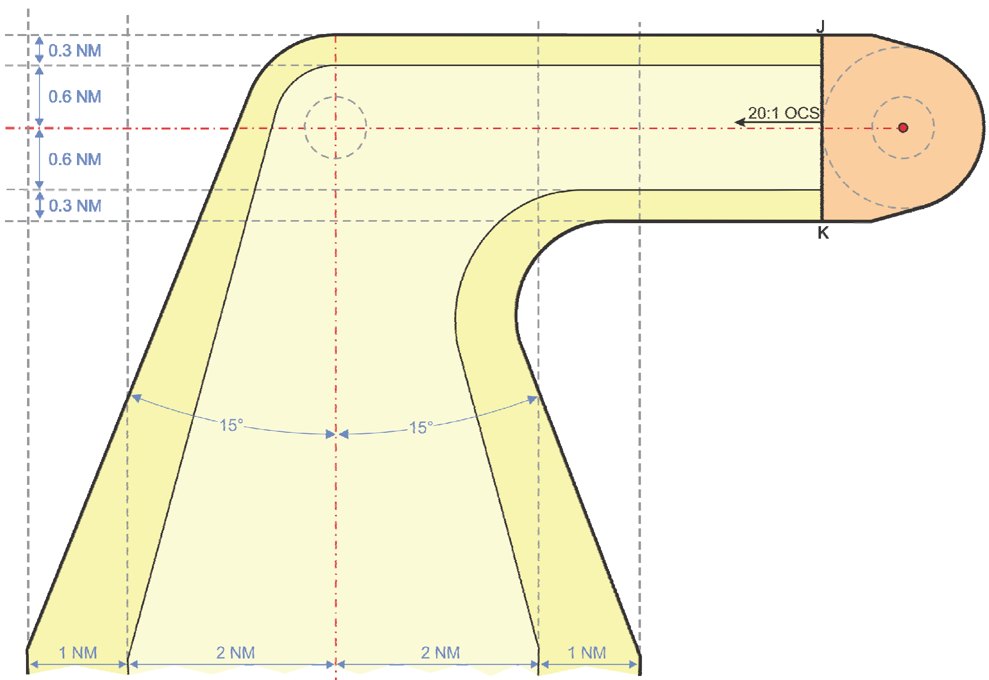


Figure 6-36. Departure Climb Area Plan View (Special)



6-9. Required Obstacle Clearance (ROC).

a. Section 1 Obstacle Clearance.

(1) The PinS DP minimum ROC at the IDF is 250 ft, plus any adjustments for RASS (when altimeter source greater than 5 NM from the IDF), precipitous terrain, and obstacle accuracy code.

Note 1: Precipitous terrain apply Section 1 only.

Note 2: IDF altitude must not be lower than the heliport elevation.

(2) ROC is applied within the IDF flat surface area (Section 1), and then rounded to the next higher 100-ft increment. For example, 500 ft remains 500 ft and 501 ft becomes 600 ft. The rounded altitude is the IDF crossing altitude.

(3) Accuracy Code. Obstacle accuracy code is 2C (50 ft horizontal/20 ft vertical) in the IDF flat surface area.

b. Section 2 Obstacle Clearance.

(1) Sloping OCS. ROC increases at 96 ft/NM for all climb gradients.

(2) Primary OEA. Apply a 20:1 OCS originating at the JK line in the direction of departure. The OCS origin elevation is equal to the IDF crossing altitude subtracting ROC and any adjustments.

(3) Secondary OEA. Apply a 6:1 OCS from the edge of the primary OEA. The OCS origin elevation is equal to the height of the primary OEA boundary directly abeam the obstacle and perpendicular to the segment track. For obstacles located within a turn OEA (see Figure 6-37).

(4) Obstacle evaluation. If the OCS is clear, then the standard CG (400 ft/NM) applies. If the OCS is not clear, then take the following actions:

(a) Publish a CG to clear the penetration(s). CGs in excess of 600 ft/NM requires Flight Standards approval.

(b) Alternatively, raise the IDF altitude to clear the penetration(s) to accommodate helicopters that cannot meet the non-standard climb gradient.

Note: This option will increase the ceiling value at the IDF.

(c) Lastly, design another DP over a different route to achieve a lower CG.

(5) Level Surface. The departure OCS continues to increase until reaching 1,000 ft of ROC for non-mountainous regions (2,000 ft for mountainous regions) to the highest obstacle

located within the primary OEA (or secondary equivalent), and round the result to the next higher 100-ft increment. For example, 5,700 ft remains 5,700 ft and 5,701 ft becomes 5,800 ft.

(6) Accuracy Code. The obstacle accuracy code for the 20:1 OCS area is 4D (250 ft horizontal/50 ft vertical).

(7) Calculate the ROC over an obstacle, the altitude at which the ROC is achieved, and the resulting required CG using Formula 6-2.

Formula 6-2. ROC/Min Alt/CG

(1) input d, $d_{secondary}$, OBS_{elev}, adj, $aircraft_{SOC}$

(2) $ROC_{OBS} = (250+adj)+\frac{96 \cdot d}{fpnm}$

(3) $OBS_{elev} = if\left[\left(OBS_{elev} - aircraft_{SOC} - \frac{d_{secondary}}{6}\right) \le 0, 0, OBS_{elev} - \frac{d_{secondary}}{6}\right]$

(4) $alt_{min} = OBS_{elev} + ROC_{OBS}$

(5) $CG_{minimum} = \textbf{ceiling}\left[\frac{r}{d} \cdot \ln\left(\frac{r+alt_{min}}{r+aircraft_{SOC}}\right) \cdot fpnm\right]$

(6) $CG_{required} = \textbf{max}[400, CG_{minimum}]$

(250+adj)+96*d/fpnm
if OBS in secondary, OBS_{elev}= OBS_{elev}- $d_{secondary}$/6
OBS_{elev}+ROC_{OBS}
ceiling(r/d*ln((r+alt_{min})/(r+$aircraft_{SOC}$))*fpnm)
max(400,$CG_{minimum}$)

Calculator		
d		Click here to calculate
$d_{secondary}$		
OBS_{elev}		
adj		
$aircraft_{SOC}$		
ROC_{OBS}		
alt_{min}		
$CG_{minimum}$		
$CG_{required}$		

6-10. Obstacle Distance Measurement. Obstacle distance (d) is measured using the shortest distance from each primary area obstacle to the JK line as illustrated in Figure 6-37 and Figure 6-38. Secondary area obstacles that occur during turn expansions have an obstacle distance that begins at the JK line and ends at the point on the edge of the primary boundary closest to the obstacle. Secondary area obstacles that do not occur during turn expansion have an obstacle distance that begins at the JK line and ends at the point of intersection of a line perpendicular to the flight path passing through the obstacle and boundary of the primary area. Secondary area obstacle evaluations are further reduced based on their distances to the primary edge boundary as shown in Formula 6-2. Detailed steps for obstacle distance measurements and calculations are found below:

a. Obstacle in the Primary evaluation. Determine obstacle evaluation distance (d), as the shortest distance within the primary area from the obstacle to the JK line.

b. Obstacle in the Secondary evaluation.

(1) Determine the intersecting element of a line drawn from the obstacle to the closest point on the flight path.

(a) If the intersecting element is an arc, determine the Obstacle Primary Point as the closest point on the primary boundary to the obstacle.

(b) If the intersecting element is not an arc, determine the Obstacle Primary Point as the point of intersection between a line drawn from the obstacle perpendicular to the flight path and the Primary Boundary.

(2) Determine obstacle evaluation distance (d), as the shortest distance within the primary area to from the Obstacle Primary Point to the JK line.

(3) Determine distance into the secondary ($d_{secondary}$) as the distance from the obstacle to the Obstacle Primary Point.

Figure 6-37. Measuring Obstacle Distance (Public)

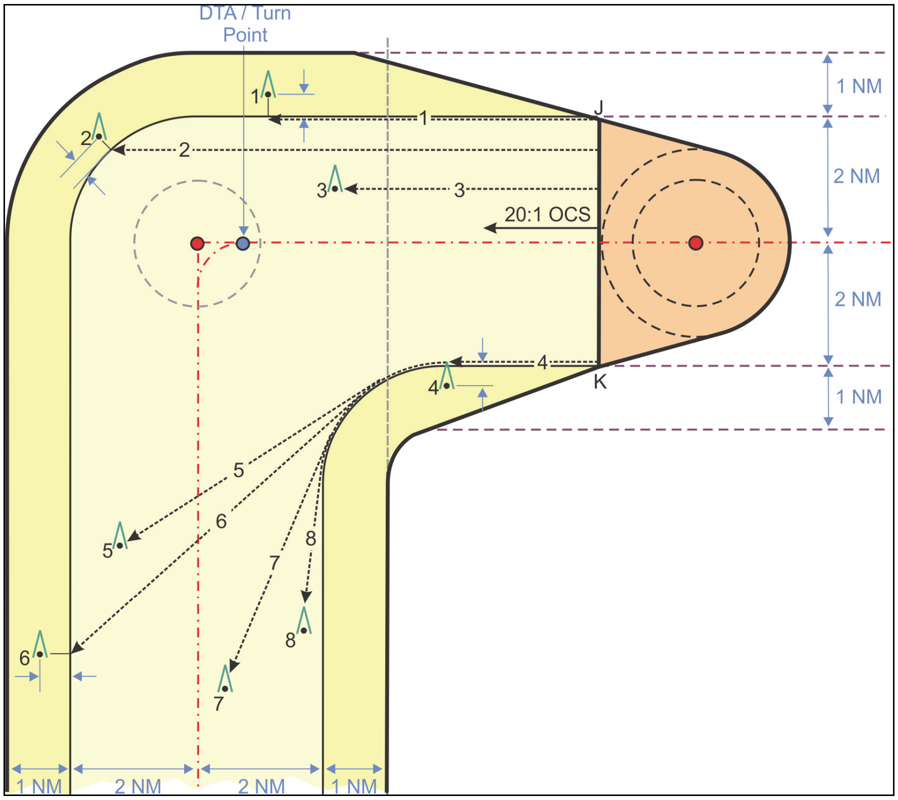
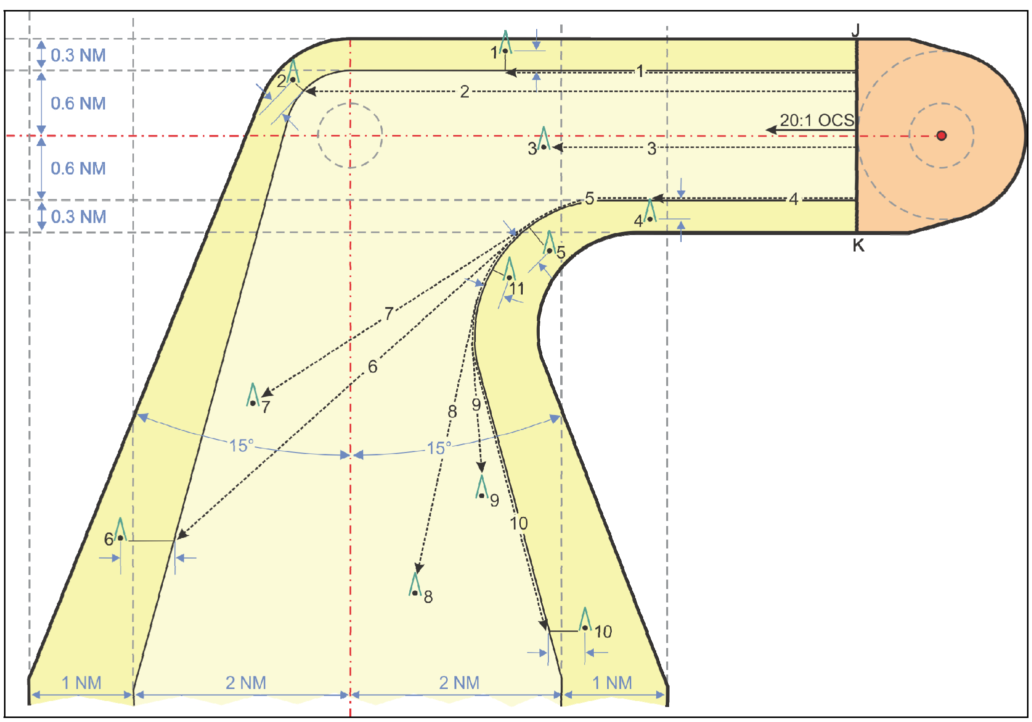


Figure 6-38. Measuring Obstacle Distance (Special)



6-11. Visual Segment (Specials only). To ensure a safe IFR operation from a heliport, it is essential to establish the acceptability of the landing site, to design a safe, flyable departure procedure, and to provide a flight inspection evaluation consistent with the type of operation. This paragraph provides the construction guidance for the visual segment of this type of procedure.

a. Procedure design. The special procedure provides a measure of obstruction protection/ identification along the visual track from a specific VFR heliport to the IDF.

Note: In most cases the DP will be developed to utilize the waypoints of a corresponding Approach Procedure, resulting in the IDF being in the same location as the MAP.

(1) Alignment. The visual segment connects the helipoint to the IDF. The optimum visual segment is aligned with the FAC. The course change at the IDF must not exceed 30 degrees.

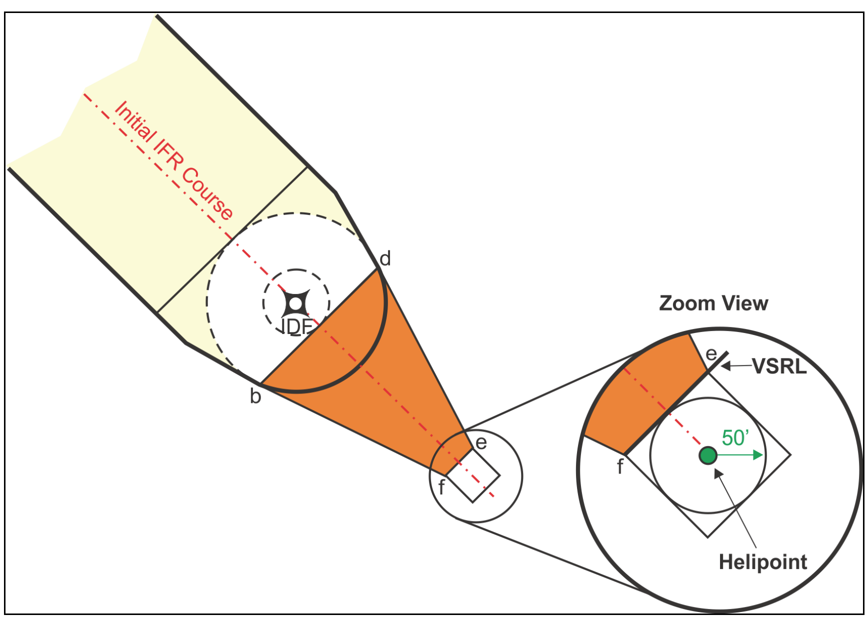
(2) Area.

(a) Length. The visual segment OEA begins at the VSRL and ends at the IDF. The visual segment OEA maximum length is 2 NM, measured from the helipoint to the IDF plotted position. The optimum helipoint to the ATD/IDF fix distance is 0.65 NM.

(b) Width. The visual segment splay begins at the VSRL. It splays from the VSRL endpoints to 0.6 NM either side of the IDF, perpendicular to the Initial IFR course.

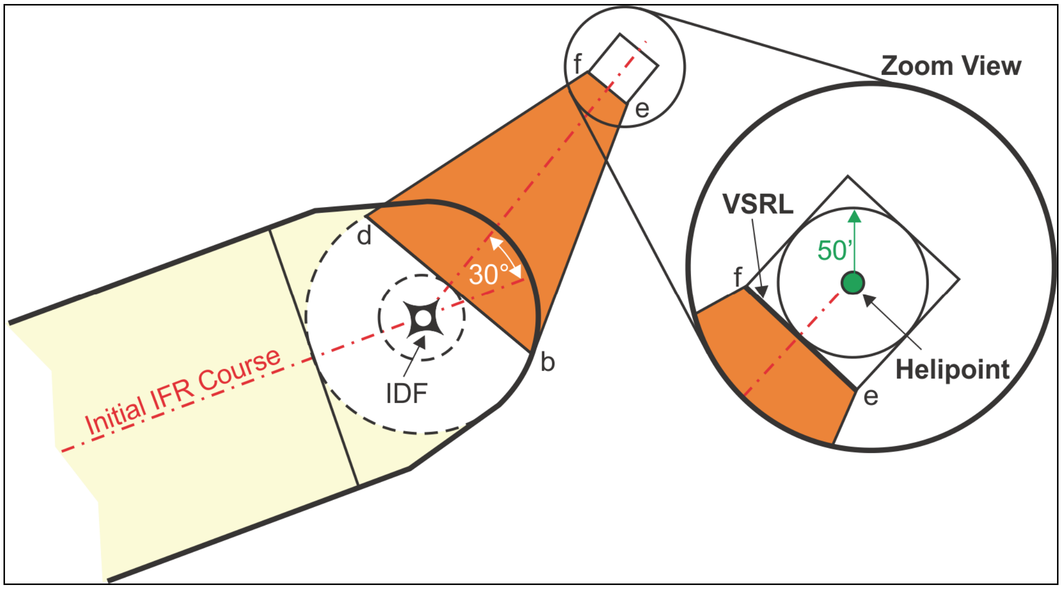
1. Straight Course Construction. Connect the VSRL outer edges (EF) to points B and D - 0.6 NM either side of the IDF, perpendicular to the Initial IFR course (see Figure 6-39).

Figure 6-39. Straight Visual Segment OEA



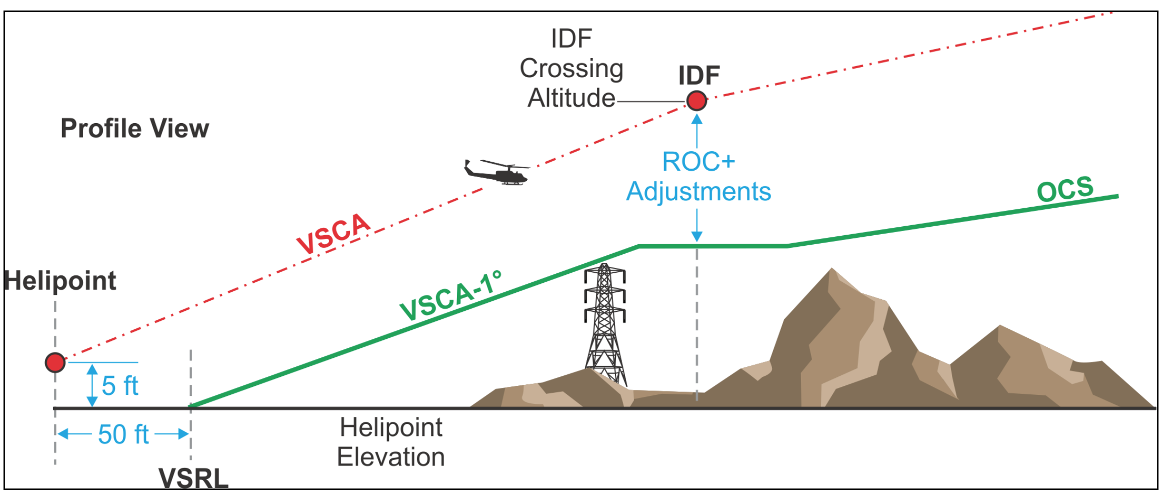
2. Turn at the IDF Construction. Connect the VSRL outer edges (EF) to points B and D - 0.6 NM either side of the IDF, perpendicular to the Initial IFR course (see Figure 6-40).

Figure 6-40. Visual Segment with Turn at IDF OEA



(c) Visual Segment Climb Angle (VSCA). The VSCA is a developer-specified angle extending from a point 5 to 20 ft directly above the helipoint to the IDF altitude (see Figure 6-41).

Figure 6-41. VSCA and OIS



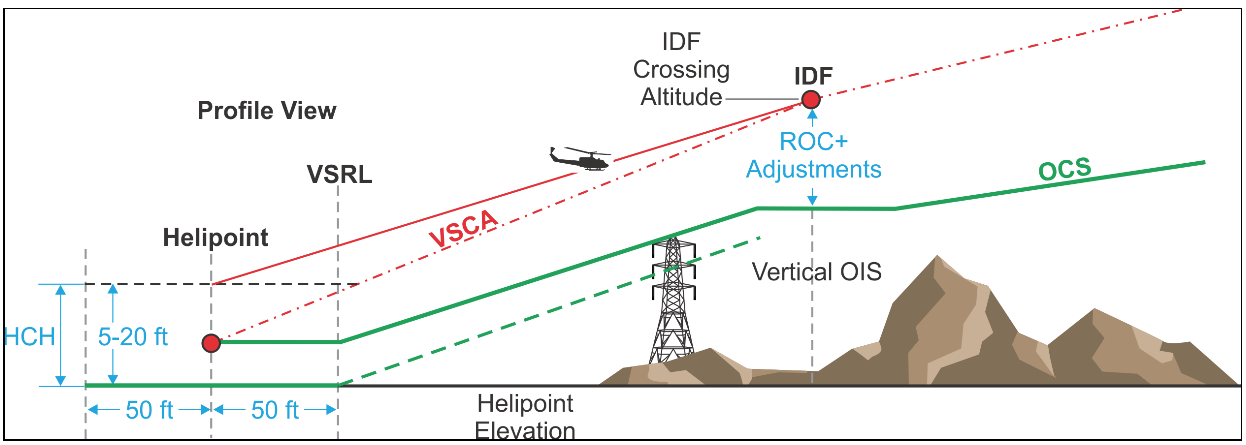
(d) Visual Segment OIS. The OIS begins at the VSRL and extends upward toward the IDF at an angle of (VSCA – 1 degree). The OIS rises to the point it reaches an altitude equal to the IDF altitude minus the ROC and adjustments, after which it becomes a level surface to the end of the IDF area. Measure obstacles using the shortest distance to the VSRL. Obstacles should not penetrate the OIS; if they penetrate in the initial evaluation; take one of the following actions, listed in preferential order (see Figure 6-42):

1. Remove or adjust obstacle location and/or height to eliminate the penetration, or

2. Raise the VSCA (Maximum 8.13°) to achieve an OIS angle that clears the obstacle, (verify that the helicopter meets this new climb performance), or

3. Raise the HCH to ≤ 20 ft. Consult with the operator to determine ability of the helicopter fleet to hover at the adjusted HCH. When this procedure is applied, raise the OIS origin above the helipoint elevation by the amount that the HCH is increased (see Figure 6-42).

Figure 6-42. VSCA and OIS Evaluation



b. Charting requirements.

(1) Annotate the procedure: "DEPART VISUALLY TO THE IDF."

(2) Publish the VSCA and climb gradient to the IDF.

(3) Chart the obstructions required by the application of the attached criteria.

(4) If the procedure is determined to be unusable at night, or night operations are not requested, annotate the procedure: "Procedure NA at night."

6-12. Weather Minimums. Calculate ceiling and visibility weather minimums required for documenting the RNAV PinS DP on FAA Form 8260-15.

a. The minimum ceiling will correspond with the IFR MSL altitude required at the IDF rounded up to the next higher 100-ft increment, or the highest HRP elevation rounded up to the next higher 100-ft increment, whichever is higher. For example, 500 ft remains 500 ft and 501 ft becomes 600 ft.

b. The visibility for a DP without a visual segment is in accordance with standard VFR minima. See FAA Form 8260-15 examples in FAA Order 8260.46, appendix F.

c. The visibility for a Special DP with a visual segment is the greater of ¾ SM or the distance between the HRP and the IDF. Conduct an obstacle evaluation of the visual segment area, ensure that a satisfactory day/night flight validation is accomplished, and obtain Flight Standards approval of the Special DP.

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Chapter 7. Minimums for Helicopter Nonprecision RNAV amd WAAS Approaches

1. Application. Minimums specified for Category "A" aircraft in Order 8260.3, Volume 1, chapter 3, apply to helicopter RNAV procedures, except as follows: For helicopter procedures to heliports or helipoints, substitute "helipoint elevation" for "airport elevation" and "height above threshold (HATh)" for "heliport crossing height (HCH)."

a. Altitudes for IFR Approaches to IFR Heliports. Heliport minimums are referenced to the helipoint elevation (HE).

b. Visibilities for IFR Approaches to IFR Heliports and Runways.

(1) Approaches to Lighted Heliports with a Heliport Approach Lighting System (HALS). Apply Order 8260.37, table 3. Apply Order 8260.3, Volume 1, chapter 3, table 3-5b for DoD helicopters.

(2) Approaches to Runways. Apply Order 8260.3, Volume 1, chapter 3, table 3-6 for civilian helicopters. The minimum visibility may be ½ the computed values in table 3-6 but not less than ¼ sm/1.200 RVR. Apply Order 8260.3, Volume 1, chapter 3, table 3-5b for DoD helicopters.

> **Note 1:** For all procedures where obstacles penetrate Order 8260.3, Volume 1, chapter 3, paragraph 3.3.2 visual surfaces, visibility credit for approach lighting systems must not reduce visibility to values less than the values specified by paragraph 3.3.2 (3/4 or 1 SM as appropriate).

> **Note 2:** For USA, when analyzing the visual position of the final approach segment and a penalty is encountered when applying the basic criteria in Order 8260.3, Volume 1, paragraph 3.3.2, apply 20:1 vice 34:1 and 10:1 vice 20:1.

c. IFR to a VFR Heliport (IVH) IFR to a VFR Runway (IVR). (Proceed Visually). The **minimum** visibility is ¾ SM. If the height above surface (HAS) exceeds 800 ft, the **minimum** visibility is 1 SM. The **minimum** visibility must not be less than the distance from the plotted position of the MAP to the helipoint. Nighttime Operations must be flight inspected and approved (see appendix A).

d. PinS Approach (Proceed VFR). The **minimum** visibility is ¾ SM. If the height above surface (HAS) exceeds 800 ft, the **minimum** visibility is 1 SM.

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Chapter 8. HLPV PinS Final Approach Segment (FAS) Evaluation

8-1. General. Helicopter specific LPV PinS criteria are based on chapter 2 OEA concepts; however, the LPV and LNAV procedure follows the same ground track and fixes and the along-track location of DA and the LNAV MAP are the same. For procedures annotated "Proceed VFR," DA must be at least 250 ft above the terrain/surface and obstacles within a radius of 5,280 ft of the latest ATT point of the LNAV/LPV MAP/DA (see Figure 8-1 and Figure 8-2). For procedures annotated "Proceed Visually" DA must be at least 250 ft HAL.

Figure 8-1. Pins LPV Reference Datum Point (RDP)

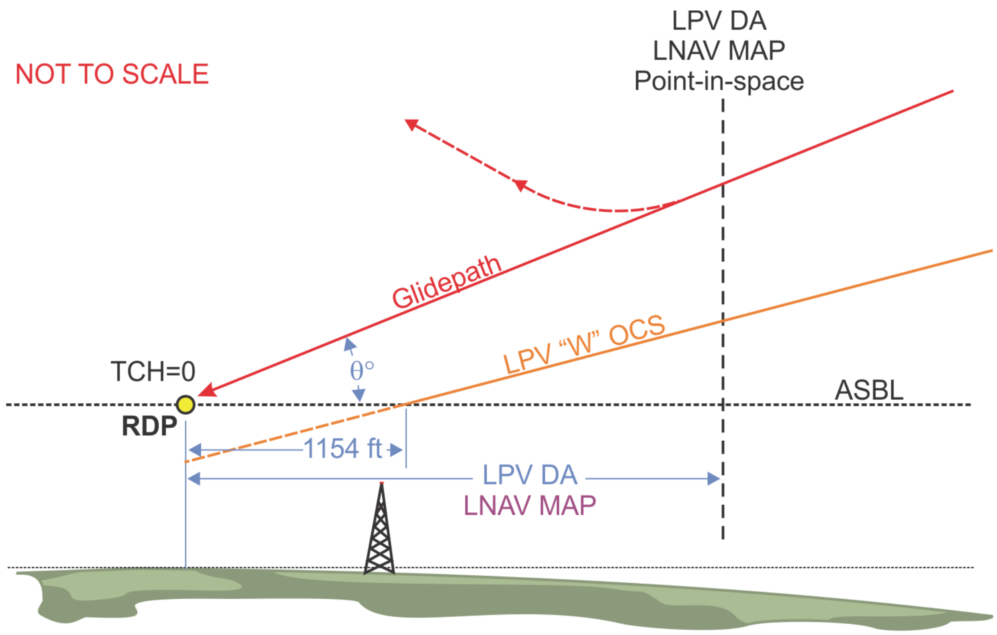
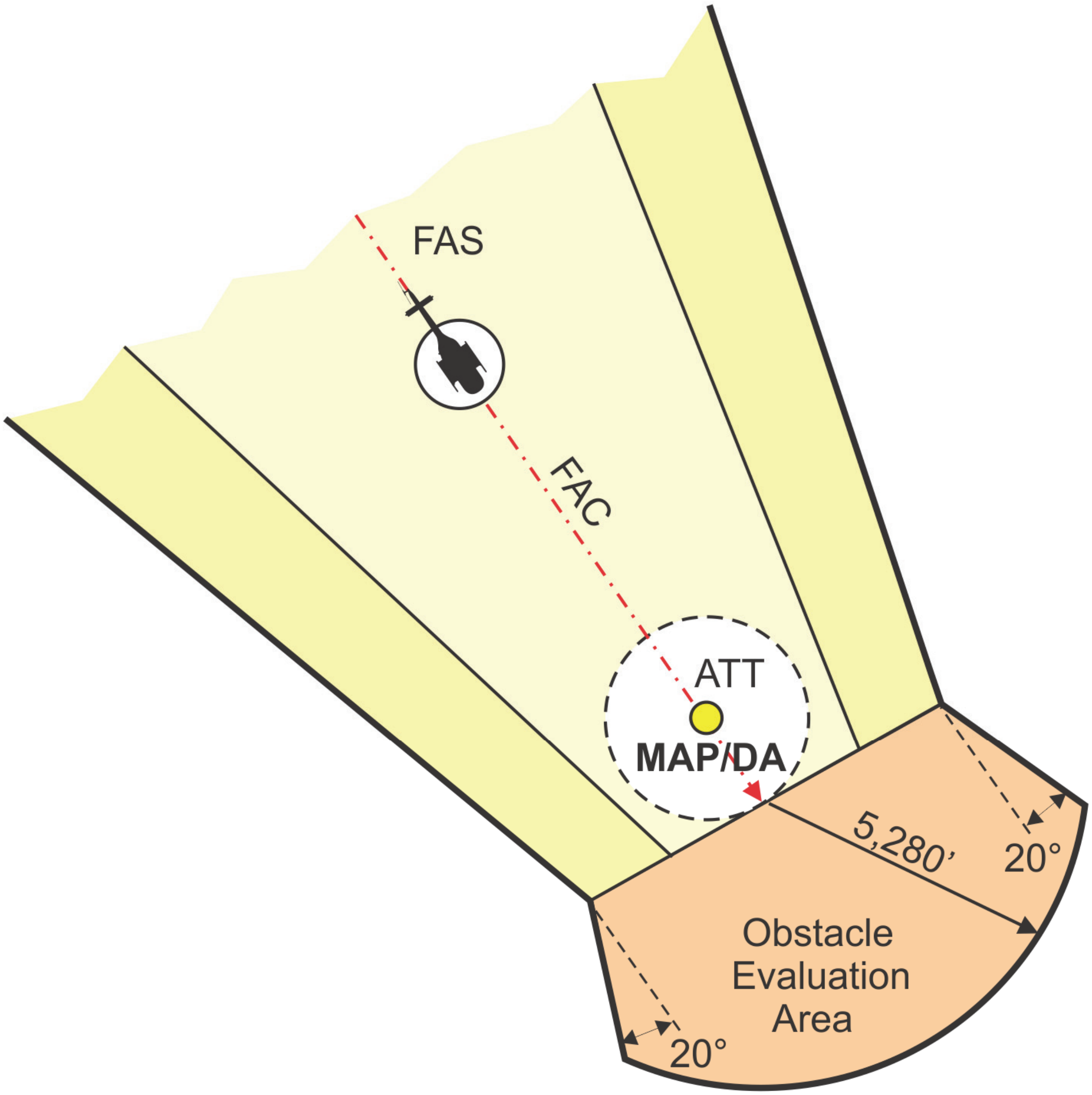


Figure 8-2. PinS VFR Area



8-2. Final Segment Obstruction Evaluation Area (OEA). The HLPV PinS final segment begins at the distance 1,154 ft from the RDP and extends to GPIP. The OEA protection extends the along-track segment dimension by the ATT value (40 m, 131.234 ft) at each end (see Figure 8-3 and Figure 8-4).

Figure 8-3. PinS OEA Plan View

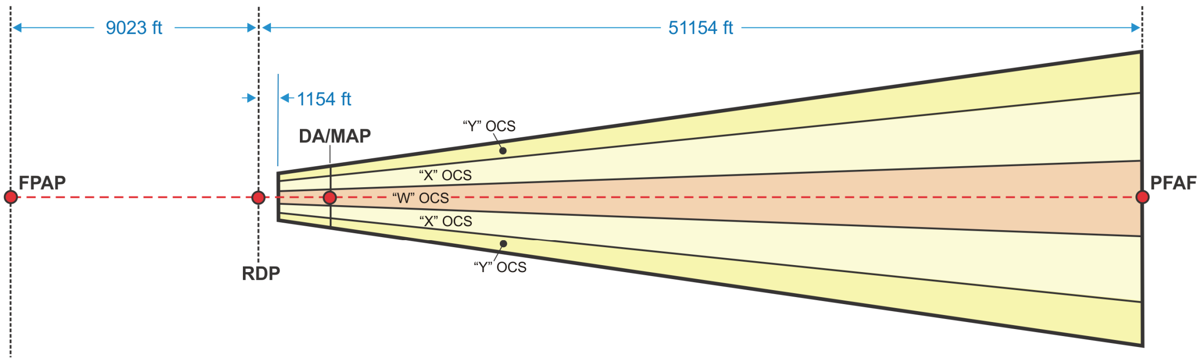
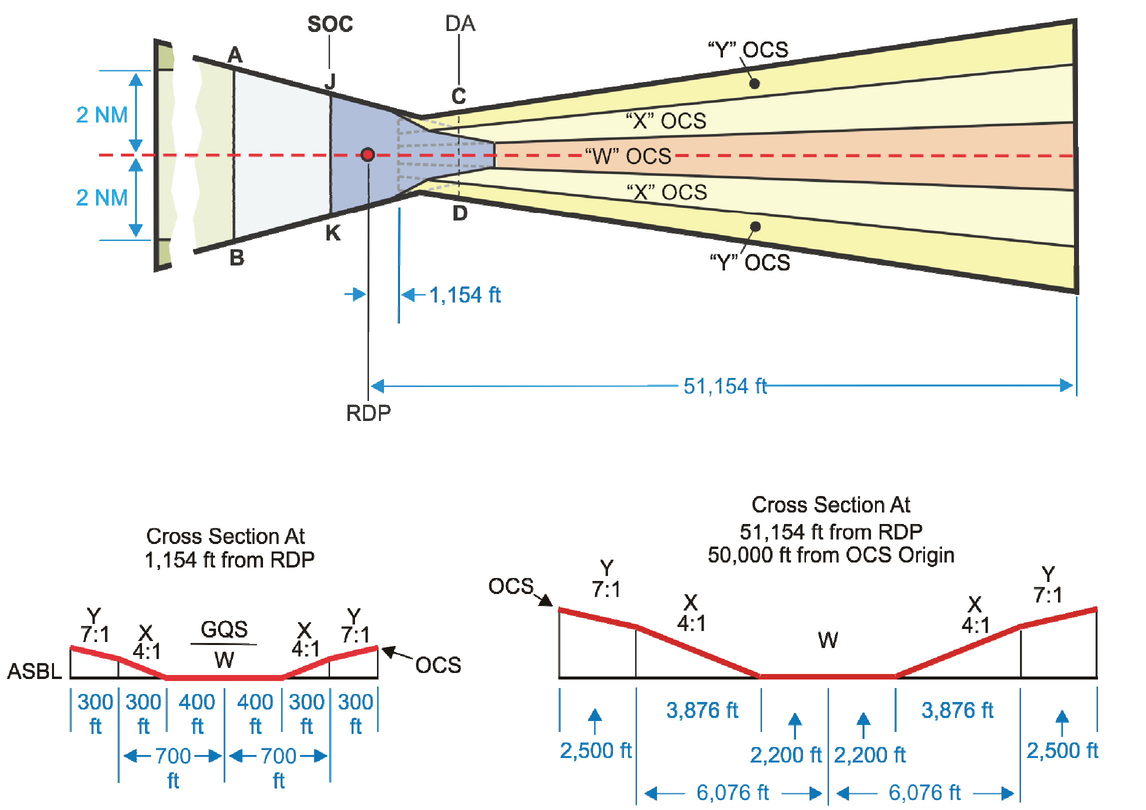


Figure 8-4. GPIP

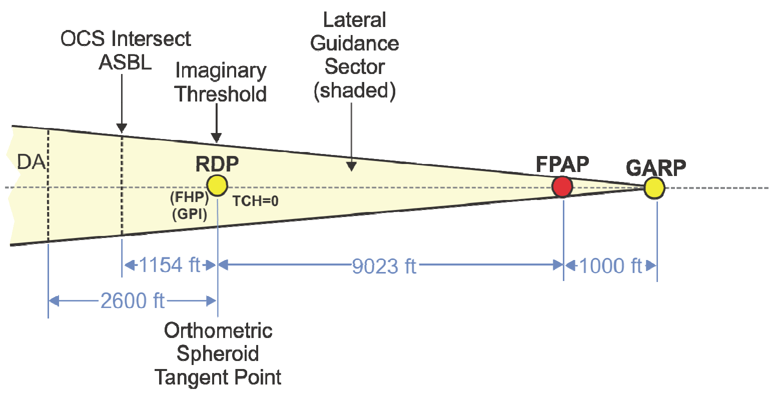


a. Calculate the distance from RDP to PFAF using Formula 2-15 (coincident with LNAV PFAF). Minimum length is 3 NM and maximum 10 NM. When using Formula 2-15 replace HCH with 0, and HRP_{elev} with RDP_{elev}.

b. Locate the FPAP 9,023 ft from RDP on a continuation of the final approach course (FAC), see Figure 8-5. The following are values entered into the procedure FAS data block (see paragraph 8-11).

Distance RDP to FPAP = 9,023 ft
Distance FPAP to GARP = 304.8 m (1,000 ft)
Course Width at RDP = 106.75 m (350 ft)

Figure 8-5. FPAP



c. OEA Alignment. The FAC is nominally aligned with landing site approach track extended (± 0.03°). Where a unique operational requirement indicates a need to offset the track from DA/MAP to the landing site from the track of the FAC, the offset must not exceed 30 degrees measured at DA.

d. OCS Slope. In this document, OCS slope is expressed as run over rise; e.g., 22.667:1. Determine the OCS slope (OCS_{slope}) associated with a specific θ° using Formula 8-1.

Formula 8-1. OCS Slope

$$(1)\ \text{input } \theta°$$

$$(2)\ OCS_{slope} = \mathbf{round}\left[\frac{102}{\theta°},3\right]$$

round(102/θ°,3)		
Calculator		
θ°		Click Here to Calculate
OCS_{slope}		

e. OCS Origin and Elevation. For obstacle evaluation, the OCS originates 1,154 ft from (prior to) the RDP at the same elevation. Along-track distance measurements in the final segment OEA are from RDP.

8-3. W OCS. All final segment OCS (W, X, and Y surfaces) obstacles are evaluated relative to the height of the W surface based on their along-track distance (OBS_X) from RDP, perpendicular distance (OBS_Y) from the FAC centerline, and MSL elevation (OBS_{elev}) adjusted for earth curvature and X/Y surface rise if appropriate. This adjusted elevation is termed obstacle effective elevation (O_{EE}) and is covered in paragraph 8-3b.

a. Half-Width. (Perpendicular distance from FAC centerline to surface boundary.) The perpendicular distance ($W_{boundary}$) from FAC centerline to the boundary is 400 ft at the point 1,154 ft from RDP and expands uniformly to 2,200 ft at a point 51,154 ft from RDP then remains constant. Calculate $W_{boundary}$ for any distance from RDP using Formula 8-2.

Formula 8-2. W OCS Half-Width

(1) input OBS_X

(2) $W_{boundary} = 0.036 \cdot (OBS_X - 954) + 392.8$

Where OBS_X = any along-track distance from RDP $\leq$ 51,154 ft

0.036*(OBS$_X$-954)+392.8		
Calculator		
OBS_X		Click Here to Calculate
$W_{boundary}$		

b. Height. Calculate the MSL height (ft) of the W OCS (W_{elev}) at any distance from RDP using Formula 8-3.

Formula 8-3. W OCS MSL Elevation

(1) input DA, θ°, OBS_X

(2) $$W_{elev} = \frac{(r + DA) \cdot \cos\left(\operatorname{atan}\left(\frac{\theta}{102}\right)\right)}{\cos\left(\frac{OBS_X - 1154}{r} + \operatorname{atan}\left(\frac{\theta}{102}\right)\right)} - r$$

(r+DA)*cos(atan(θ°/102))/cos((OBSX-1154)/r+atan(θ°/102))-r		
Calculator		
DA		Click Here to Calculate
θ°		
OBS_X		
W_{elev}		

The glide path is a straight line in space extending from RDP. The OCS is; therefore, a flat plane (does not follow earth curvature) to protect the straight-line glide path. The elevation of the OCS at any point is the elevation of the OCS at the FAC centerline abeam it. Since the earth's surface curves away from these surfaces as distance from RDP increases, the MSL elevation (OBS_{elev}) of an obstacle is reduced to account for earth curvature. This reduced value is termed the obstacle effective elevation (O_{EE}). Calculate O_{EE} using Formula 8-4 with adjustment "Q" for "X" or "Y" surface rise (0 if in W Surface).

Formula 8-4. Calculation of O_{EE}

(1) input OBS_{elev}, DA, OBS_Y, Q

$$(2)\ O_{EE} = OBS_{elev} - \left((r + DA) \cdot \left(\frac{1}{\cos\left(\frac{OBS_Y}{r}\right)} - 1 \right) + Q \right)$$

OBS$_{elev}$-((r+DA)*(1/cos(OBS$_Y$/r)-1)+Q)		
Calculator		
OBS_{elev}		Click Here to Calculate
DA		
OBS_Y		
Q		
O_{EE}		

c. W OCS Evaluation. Compare the obstacle O_{EE} to W_{elev} at the obstacle location. Lowest minimums are achieved when the W surface is clear. To eliminate or avoid a penetration, take one or more of the following actions listed in the order of preference.

(1) Remove or adjust the obstruction location and/or height.

(2) Raise the GPA (see paragraph 8-7) up to a maximum GPA of 9 degrees.

(3) Adjust DA (for existing obstacles only) see paragraph 8-6.

(4) Raise RDP elevation

(5) Adjust Final Approach Course.

8-4. X OCS.

a. Width. Calculate the perpendicular distance ($X_{boundary}$) from the FAC centerline to the X surface boundary using Formula 8-5.

Formula 8-5. Perpendicular Distance to "X" Boundary

$$(1)\ \ input\ \ OBS_X$$

$$(2)\ \ X_{boundary} = 0.10752 \cdot (OBS_X - 954) + 678.496$$

0.10752*(OBS$_X$-954)+678.496		
Calculator		
OBS_X		Click Here to Calculate
$X_{boundary}$		

b. X Surface Obstacle Elevation Adjustment (Q). The X OCS begins at the height of the W surface and rises at a slope of 4:1 in a direction perpendicular to the FAC. The MSL elevation of an obstacle in the X surface is adjusted (reduced) by the amount of surface rise. Use Formula 8-6 to determine the obstacle height adjustment (Q) for use in Formula 8-4. Evaluate the obstacle under paragraphs 8-3b and 8-3c.

Formula 8-6. X OCS Obstacle Height Adjustment

$$(1)\ \ input\ \ OBS_Y\ ,\ W_{boundary}$$

$$(2)\ \ Q = \frac{OBS_Y - W_{boundary}}{4}$$

(OBS$_y$-W$_{boundary}$)/4		
Calculator		
OBS_y		Click Here to Calculate
$W_{boundary}$		
Q		

8-5. Y OCS.

a. Width. Calculate the perpendicular distance ($Y_{boundary}$) from the FAC centerline to the Y surface boundary using Formula 8-7.

Formula 8-7. Perpendicular Distance to "Y" Boundary

$$(1)\quad input\ \ OBS_X$$

$$(2)\quad Y_{boundary} = 0.15152 \cdot (OBS_X - 954) + 969.696$$

0.15152*(OBS$_X$-954)+969.696		
Calculator		
OBS_X		Click Here to Calculate
$Y_{boundary}$		

b. Y Surface Obstacle Elevation Adjustment (Q). The Y OCS begins at the height of the X surface and rises at a slope of 7:1 in a direction perpendicular to the FAC. The MSL elevation of an obstacle in the Y surface is adjusted (reduced) by the amount of X and Y surface rise. Use Formula 8-8 to determine the obstacle height adjustment (Q) for use in Formula 8-4. Evaluate the obstacle under paragraphs 8-3b and 8-3c.

Formula 8-8. Y OCS Obstacle Height Adjustment

$$(1)\quad input\ \ X_{boundary},\ W_{boundary},\ OBS_Y$$

$$(2)\quad Q = \frac{X_{boundary} - W_{boundary}}{4} + \frac{OBS_Y - X_{boundary}}{7}$$

($X_{boundary}$-$W_{boundary}$)/4+(OBS_y-$X_{boundary}$)/7		
Calculator		
$X_{boundary}$		Click Here to Calculate
$W_{boundary}$		
OBS_Y		
Q		

8-6. HAS and DA. Where the OCS is clear, the minimum HAS is the greater of 250 ft.

a. DA Calculation (Clear OCS). The minimum DA value is 250 ft above the highest obstruction (terrain+obstacle or vegetation) rounded to the next higher 1-ft increment.

b. DA Adjustment to mitigate OCS Penetration. Calculate the adjusted DA for an obstacle penetration of the OCS using Formula 8-9.

Formula 8-9. Adjusted DA

$$(1)\quad input\ \ \theta°,\ DA,\ O_{EE}$$

$$(2)\quad D_{adjusted} = r\cdot\left(\frac{\pi}{2}-\mathbf{atan}\left(\frac{\theta°}{102}\right)-\mathbf{asin}\left(\frac{\mathbf{cos}\left(\mathbf{atan}\left(\frac{\theta°}{102}\right)\right)\cdot\left(r+DA-954-\frac{\theta°\cdot 954}{102}\right)}{r+O_{EE}}\right)\right)$$

$$(3)\quad DA_{adjusted} = \mathbf{ceiling}\left[\frac{(r+DA-954)\cdot\mathbf{cos}\left(\theta°\cdot\frac{\pi}{180}\right)}{\mathbf{cos}\left(\frac{D_{adjusted}}{r}+\theta°\cdot\frac{\pi}{180}\right)}-r\right]$$

r*(π/2-atan(θ°/102)-asin(cos(atan(θ°/102))*(r+DA-954-θ°*954/102)/(r+O$_{EE}$))) ceiling((r+DA-954)*cos(θ°*π/180)/cos(D$_{adjusted}$/r+θ°*π/180)-r)		
Calculator		
$\theta°$		Click Here to Calculate
DA		
O_{EE}		
$D_{adjusted}$		
$DA_{adjusted}$		

8-7. Revising Glide Path Angle (θ°$_{adjusted}$) for OCS Penetrations. Raising the θ° may eliminate OCS penetrations. To determine θ°$_{adjusted}$, use Formula 8-10.

Formula 8-10. Glide Path Angle Adjustment

$$(1)\ input\ OBS_X,\ OBS_{elev},\ RDP_{elev}$$

$$(2)\ s = (r+RDP_{elev})^2 + (r+OBS_{elev})^2 - 2\cdot(r+RDP_{elev})\cdot(r+OBS_{elev})\cdot\cos\left(\frac{OBS_X-1154}{r}\right)$$

$$(3)\ b = \mathbf{acos}\left(\frac{(r+RDP_{elev})^2 + s - (r+OBS_{elev})^2}{2\cdot(r+RDP_{elev})\cdot\sqrt{s}}\right) - \frac{\pi}{2}$$

$$(4)\ OCS_{adjusted\_slope} = \mathbf{round}\left(\frac{1}{\tan(b)},2\right)$$

$$(5)\ \theta_{adjusted} = \mathbf{round}\left(\frac{102}{OCS_{adjusted\_slope}},2\right)$$

(r+RDP$_{elev}$)^2+(r+OBS$_{elev}$)^2-2*(r+RDP$_{elev}$)*(r+OBS$_{elev}$)*cos((OBS$_X$-1154)/r) acos(((r+RDP$_{elev}$)^2+s-(r+OBS$_{elev}$)^2)/(2*(r+RDP$_{elev}$)*sqrt(s)))-π/2 OCS$_{adjusted_slope}$=round(1/tan(b),2) θ$_{adjusted}$=round(102/OCS$_{adjusted_slope}$,2)

Calculator		
OBS_X		Click Here to Calculate
OBS_{elev}		
RDP_{elev}		
$OCS_{adjusted\_slope}$		
$\theta^{o}_{adjusted}$		

The descent rate of the adjusted glidepath angle should not exceed 800 ft/min. Descent rate is heavily dependent on airspeed. Determine the airspeed that yields 800 ft/min ($V_{KIAS\_800ft\_min}$) for the adjusted glidepath angle using Formula 8-11. If $V_{KIAS\_800ft\_min}$ is less than the normal approach speed, publish a final approach airspeed restriction of $V_{KIAS\_800ft\_min}$. The minimum adjusted glidepath angle should not be less than three degrees. If operationally required, with Flight Standards (FS) approval, the maximum descent rate can be increased to 1,000 ft/min.

Formula 8-11. Descent Rate Indicated Airspeed

$$(1)\quad \mathit{input}\quad \theta°_{adjusted},\ DA$$

$$(2)\quad V_{KIAS\ \_800*ft\ /min} = \mathbf{round}\left[\left(\frac{800*}{101.26859\cdot \sin\left(\theta°_{adjusted}\cdot \frac{\pi}{180}\right)}-10\right)\cdot \frac{(288-0.00198\cdot DA)^{2.628}}{171233\cdot \sqrt{303-0.00198\cdot DA}},0\right]$$

*1000 when the airspeed limit is required for 1000 ft/min

round[(800/(101.26859*sin(θ°$_{adjusted}$*π/180))-10)*((288-0.00198*DA)^2.628)/(171233*sqrt(303-0.00198*DA)),0]		
Calculator		
$\theta°_{adjusted}$		Click Here to Calculate
DA		
$V_{KIAS\_800ft/min}$		
$V_{KIAS\_1000ft/min}$ (with FS approval)		

8-8. Adjusting TCH to Reduce/Eliminate OCS Penetrations. NA for PinS LPV procedures.

8-9. Missed Approach Section 1 (Height Loss and Initial Climb). Section 1 begins at DA (CD line) and ends at the AB line. It accommodates height loss and establishment of missed approach climb gradient. Obstacle protection is based on an assumed minimum climb gradient of 400 ft/NM (≈15.19:1 slope). Section 1 is centered on a continuation of the FAC and is subdivided into sections 1a and 1b (see Figures 8-6 and 8-7).

Figure 8-6. Section 1 3D Perspective

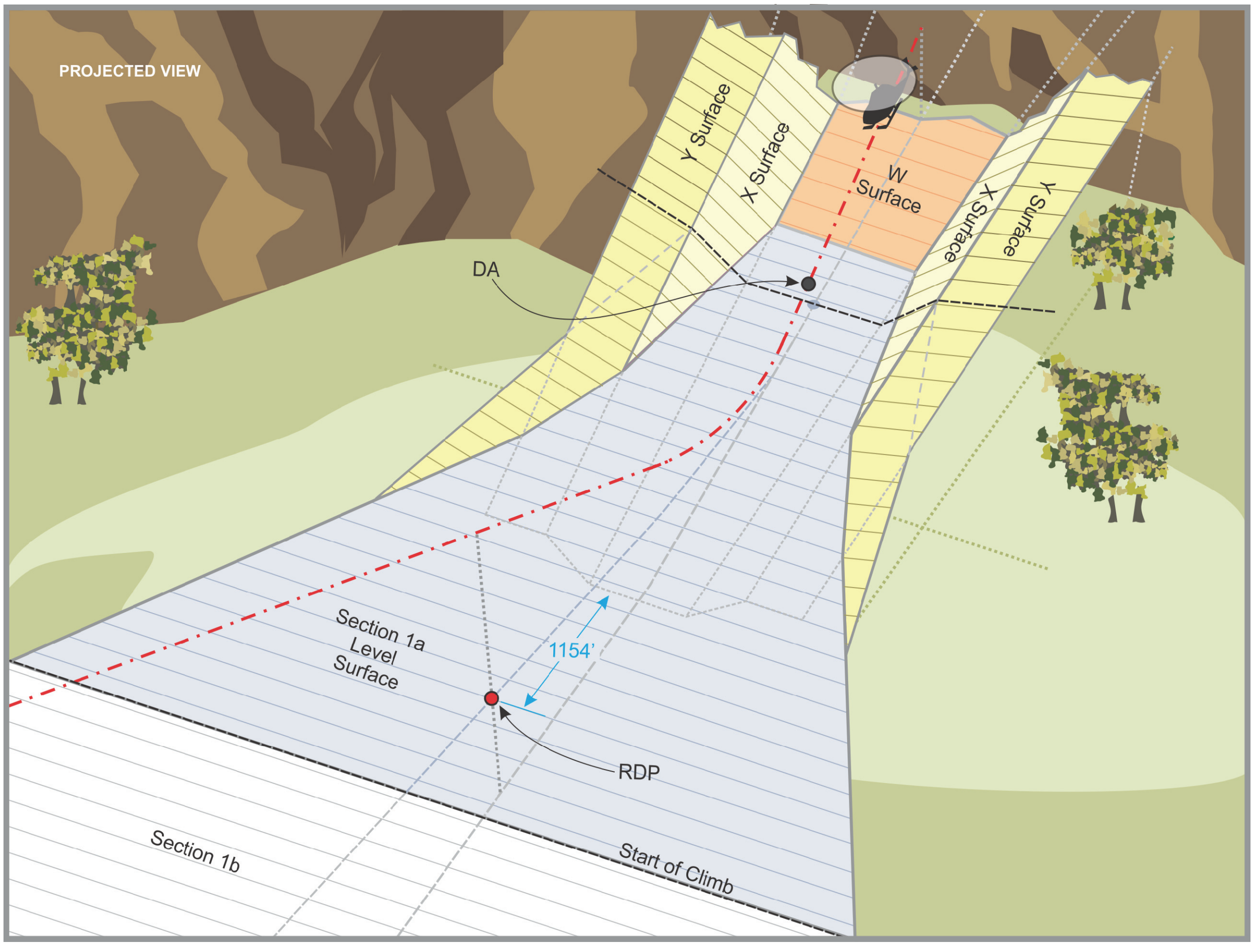
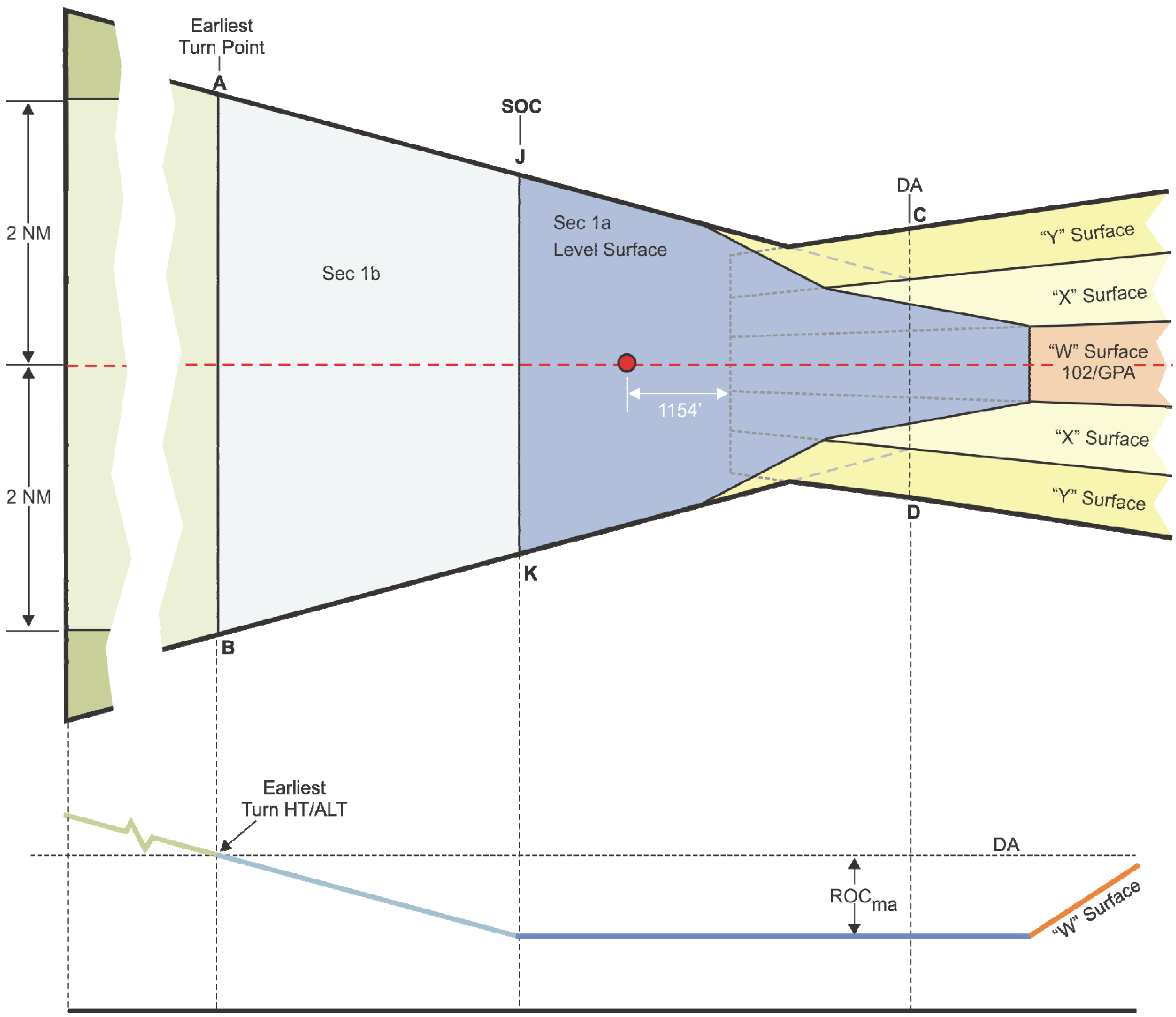


Figure 8-7. Section 1 (a/b) 2D Perspective



a. Missed Approach Section 1. Section 1 begins at DA (CD line) and ends at the JK line which is the Start-Of-Climb (SOC) point. It accommodates reconfiguration, inherent height loss, and establishing required missed approach climb gradient (CG_{MA}) of 400 ft/NM (20:1 slope), unless higher climb gradients and the appropriate slope adjustments are authorized. Section 1 is subdivided into sections 1a and 1b, and is centered on a continuation of the FAC. These surfaces must not be penetrated. Section 1a, is protected by a level surface that provides required ROC (ROC_{sec_1a}) based on glide path angle and airspeed. ROC is 115 ft for glide path angles up to 3.2 degrees. Apply ROC adjustments for glide path angles exceeding 3.2 degrees, for RDP elevations greater than 3,000 ft., and for final indicated airspeed. Calculate section 1a ROC (ROC_{sec_1a}) and the level surface MSL elevation (sec_1a_{elev}) using Formula 8-12.

Formula 8-12. MA Beginning ROC

(1) input $DA,\ RDP_{elev},\ \theta°,\ V_{KIAS}$

(2) **if** $(\theta° > 3.2°)$ **then**

$$\theta°_{adjustment} = 0.05 \cdot 25 \cdot \frac{\theta° - 3.2}{0.1}$$

else

$$\theta°_{adjustment} = 0$$

end if

(3) **if** $(RDP_{elev} > 3000)$ **then**

$$Elev_{adjustment} = 0.02 \cdot 25 \cdot \frac{RDP_{elev}}{1000}$$

else

$$Elev_{adjustment} = 0$$

end if

(4) $$ROC_{sec\_1a} = 115 + \theta°_{adjustment} + Elev_{adjustment} - 25 \cdot \frac{90 - V_{KIAS}}{90}$$

(5) $$Level\_sfc_{elev} = DA - ROC_{sec\_1a}$$

0.05*25*(θ° -3.2)/0.1
0.02*25*RDP_{elev}/1000
115+$\theta°_{adjustment}$+$Elev_{adjustment}$-25*(90-V_{KIAS})/90
DA- ROC_{sec_1a}

Calculator		
DA		Click Here to Calculate
RDP_{elev}		
$\theta°$		
V_{KIAS}		
ROC_{sec_1a}		
$Level\_sfc_{elev}$		

(1) Section 1a. Section 1a length varies with altitude, airspeed, and glide path angle. The 1a surface splays at 15 degrees relative the FAC extension, from X boundary at its beginning (CD line) until reaching the JK line. Calculate X width at section 1a start point using the final segment X width. Calculate section 1a length ($Length_{sec1a}$) using Formula 8-13.

Formula 8-13. Section 1a Length

$$(1) \quad input\ \theta°,\ V_{KTAS} \quad \left\{ \begin{array}{l} Use\ V_{KIAS}\ of\ the\ final\ approach\ speed \\ appropriate\ for\ glidepath\ angle\ plus \\ 10\ knots\ in\ V_{KTAS}\ calculation \end{array} \right\}$$

$$(2) \quad anpe = 1.225 \cdot \frac{40}{0.3048}$$

$$(3) \quad wpr = 60 \cdot \tan\left(\theta \cdot \frac{\pi}{180}\right)$$

$$(4) \quad fte = \frac{75}{\tan\left(\theta \cdot \frac{\pi}{180}\right)}$$

$$(5) \quad d1 = 10 \cdot \frac{(V_{KTAS} + 10) \cdot fpnm}{3600}$$

$$(6) \quad Length_{sec1a} = \mathbf{round}\left[d1 + \frac{4}{3} \cdot \sqrt{anpe^2 + wpr^2 + fte^2}, 0\right]$$

1.225*40/0.3048 60*tan(θ°*π/180) 75/tan(θ°*π/180) 10*(V_{KTAS}+10)*fpnm/3600 round(d1+(4/3)*(anpe^2+wpr^2+fte^2)^0.5,0)

Calculator		
$\theta°$		Click Here to Calculate
V_{KTAS}		
$Length_{sec1a}$		

(a) Calculate the 1a surface half-width (½$width_{sec1a}$) at any along-track distance (d_{1a}) from DA assuming a beginning half-width of the final segment "X" surface at DA (½X_{sfc_DA}) using Formula 8-14.

Formula 8-14. Section 1a Width

(1) input d_{1a}, DA, RDP_{elev}, $\theta°$

(2) $$\frac{1}{2}width_{sec1a} = d_{1a} \cdot \tan\left(15 \cdot \frac{\pi}{180}\right) + 0.036 \cdot \left(\frac{DA - RDP_{elev}}{\tan\left(\theta° \cdot \frac{\pi}{180}\right)} - 954\right) + 398.2$$

d

d_{1a}*tan(15*π/180)+0.036*((DA-RDP_{elev})/tan(θ°*π/180)-954)+398.2		
Calculator		
d_{1a}		Click Here to Calculate
DA		
RDP_{elev}		
θ°		
½$width_{sec1a}$		

(b) Obstacles within the lateral boundaries of the flat surface that underlie the X or Y surfaces may be evaluated against the higher of: (1) the W surface abeam the obstacle, or (2) the flat surface elevation. Conduct the evaluation using the "Obstacle Effective Elevation" (O_{EE}).

(2) Section 1b. Section 1b provides initial climb protection from SOC at the specified CG_{MA} until minimum turn height/altitude (alt_{turn}) is attained. Its lateral boundaries continue the section 1a splay until alt_{turn} is reached or until reaching full width, whichever occurs first. Calculate section 1b length using Formula 8-15.

Formula 8-15. Section 1b Length

$$(1) \quad input \quad alt_{turn},\ Level\_sfc_{elev},\ CG_{MA}$$

$$(2) \quad Length_{sec1b} = \frac{r \cdot fpnm \cdot \ln\left[\dfrac{r + alt_{turn}}{r + Level\_sfc_{elev}}\right]}{CG_{MA}}$$

r*fpnm*ln((r+alt$_{turn}$)/(r+Level_sfc$_{elev}$))/CG$_{MA}$		
Calculator		
alt_{turn}		Click Here to Calculate
$Level\_sfc_{elev}$		
CG_{MA}		
$Length_{sec1b}$		

(a) Calculate the width of the section 1b surface (½width$_{sec1b}$) at any distance d_{sec1a_end} from the end of section 1a using Formula 8-16.

Formula 8-16. Section 1b Width

$$(1) \quad input \ d_{sec1a\_end},\ \tfrac{1}{2}width_{sec1a}$$

$$(2) \quad \tfrac{1}{2}width_{sec1b} = d_{sec1a\_end} \cdot \tan\left(15 \cdot \tfrac{\pi}{180}\right) + \tfrac{1}{2}width_{sec1a}$$

d$_{sec1a_end}$*tan(15*π/180)+1/2width$_{sec1a}$		
Calculator		
d_{sec1a_end}		Click Here to Calculate
½width$_{sec1a}$		
½width$_{sec1b}$		

(b) The surface rises at a rate related to the assigned CG_{MA} from sec_1a$_{elev}$. Determine the 1b MA surface elevation (OCS_1b$_{OBS_x}$) at any section 1b obstacle distance (d), and the elevation of the OCS at section 1b end (OCS_1b$_{end_elev}$) using Formula 8-17.

Formula 8-17. MA Slope and Section 1b Elevation

$$(1)\ \text{input } CG_{MA},\ d_{sec1b\_end},\ Level\_sfc_{elev},\ OBS_x$$

$$(2)\ MA_{slope} = \frac{fpnm}{CG_{MA} - 96}$$

$$(3)\ OCS\_1b_{end\_elev} = \frac{d_{sec1b\_end}}{MA_{slope}} + Level\_sfc_{elev}$$

$$(4)\ OCS\_1b_{OBS\_x} = \frac{OBS_x}{MA_{slope}}$$

$fpnm/(CG_{MA}-96)$
$d_{sec1b\_end}/MA_{slope}+Level\_sfc_{elev}$
OBS_x/MA_{slope}

Calculator		
CG_{MA}		Click Here to Calculate
d_{sec1b_end}		
$Level\_sfc_{elev}$		
OBS_x		
MA_{slope}		
$OCS\_1b_{end\_elev}$		
$OCS\_1b_{OBS\_X}$		

b. Section 2. See chapter 5.

8-10. Surface Height Evaluation.

a. Section 1a. Obstacles that penetrate these surfaces are mitigated during the final segment OCS evaluation. However, missed approach segment penetrations are not allowed and must be mitigated by:

(1) Removing or reducing obstruction height.

(2) Adjusting RDP elevation.

(3) Adjusting the FAC.

(4) Adjusting DA (for existing obstacles).

(5) A combination of the above mitigations.

b. Section 1b/Section 2 Surface Penetration. The CG_{MA} may be increased, (if operationally feasible) in addition to the options listed in paragraph 8-11a. Climb gradients above 600 ft/NM require Flight Standards approval.

Note: See formula 5-3 to determine CG_{MA} increase method.

c. End of Section 1 Values. Calculate the assumed aircraft MSL altitude at the end of section 1b ($acft_{1b\_alt}$), the OCS MSL elevation at the end of section 1b (OCS_{1b_elev}), and the ROC at section 1b end (ROC_{end_1b}) using Formula 8-18.

Formula 8-18. Section 1b End Values

(1) $input\ DA,\ OCS\_1a_{elev},\ Length_{sec1b},\ CG_{MA}$

(2) $MA_{slope} = \dfrac{fpnm}{CG_{MA} - 96}$

(3) $acft_{1b\_alt} = DA + \left(CG_{MA} \cdot \dfrac{Length_{sec1b}}{fpnm} \right)$

(4) $OCS_{1b\_elev} = OCS\_1a_{elev} + \dfrac{Length_{sec1b}}{MA_{slope}}$

(5) $ROC_{end\_1b} = acft_{1b\_alt} - OCS_{1b\_elev}$

fpnm/(CG_{MA}-96) DA+(CG_{MA}*$Length_{sec1b}$/fpnm) OCS_1a_{elev}+ $Length_{sec1b}$/MA_{slope} $acft_{1b\_alt}$-OCS_{1b_elev}		
Calculator		
DA		Click Here to Calculate
OCS_1a_{elev}		
$Length_{sec1b}$		
CG_{MA}		
$acft_{1b\_alt}$		
OCS_{1b_elev}		
ROC_{end_1b}		

8-11. Final Approach Segment (FAS) Data Requirements. Values are as indicated unless otherwise specified.

a. Operation type: 0

b. Service Provider Identifier: 0

c. Airport Identifier: Use the heliport identifier. If the heliport does not have an identifier one must be obtained. For procedures serving multiple heliports, the identifier for the primary heliport should be used.

d. Runway Number: Final approach track rounded to nearest 10 degrees and enter as a two digit number.

e. Runway Letter: Leave blank.

f. Approach Performance Designator: 0

g. Route Indicator: Leave blank.

h. Reference Path Data Selector (RPDS): 0

i. Reference Path Identifier: [W] [Final approach track rounded to nearest 10 degrees (2 digits)] [“A” first procedure, “B” second procedure, etc.] EXAMPLE: W23A.

j. LTP/RDP Latitude: WGS-84 Latitude of RDP entered to five ten-thousandths of an arc second. The last digit must be rounded down to either a 0 or 5. EXAMPLE: 225436.2128N (*11 characters*) is entered for 22°54’36.2125”N.

k. LTP/RDP Longitude: WGS-84 Longitude of RDP entered to five ten-thousandths of an arc second. The last digit must be rounded to either a 0 or 5. EXAMPLE: 1093247.8783E (12 characters) is entered for 109°32’47.8780”E.

l. LTP/RDP height above ellipsoid (HAE): HAE value for RDP. The value is entered in meters using 5 characters. The first character is a + or – and the resolution value is in tenths of a meter. EXAMPLE: +00356 (+35.6 m), -00022 (-2.2 m).

m. Flight Path Alignment Point (FPAP) Latitude: WGS-84 Latitude of FPAP using the same requirements as paragraph 8-11j.

n. Flight Path Alignment Point (FPAP) Longitude: WGS-84 Longitude of FPAP using the same requirements as paragraph 8-11k.

o. TCH: 0000.0

p. TCH Units Selector: F (feet) or M (Meters)

q. Glidepath Angle: Specify in degrees, resolution of hundredths of a degree using 4 characters. EXAMPLE: 04.50

r. Course Width at Threshold: 106.75

s. ΔOffset: 0

t. Horizontal Alert Limit (HAL): 40

u. Vertical Alert Limit (VAL): 50

v. Final Approach Segment CRC Remainder: 32 bit cyclic redundancy check (CRC) appended to the end of each FAS Data Block in order to ensure approach data integrity. The CRC word is calculated on the entire data block.

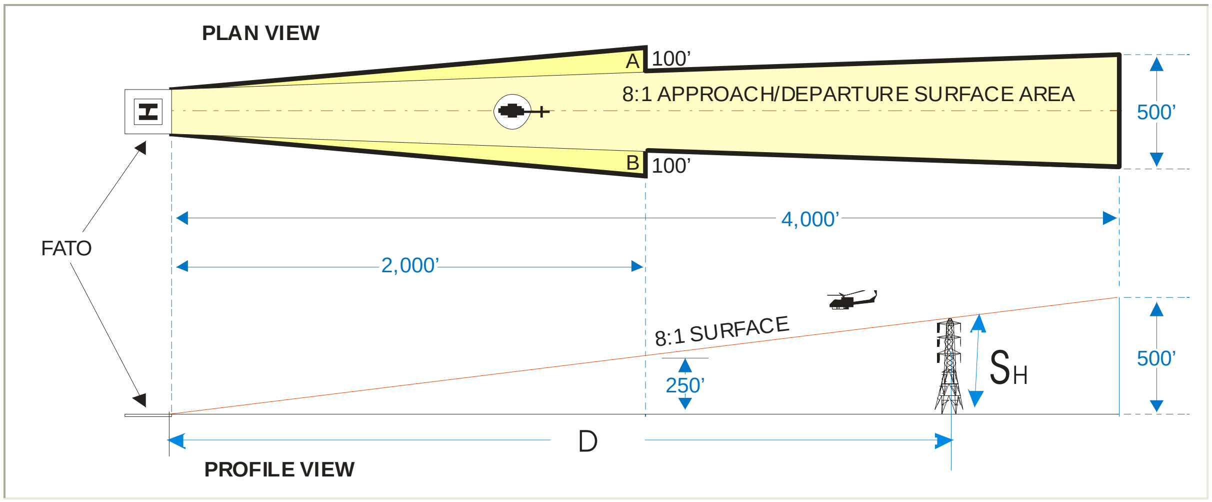
Appendix A. Conditions and Assumptions for IFR to VFR Heliport (IVH) (Proceed Visually) Approach Procedures

Before designing a special RNAV (GPS) IFR to a VFR heliport (IVH) approach procedure, ensure the heliport meets the following criteria:

1. FAA Form 7480-1, Notice of Landing Area Proposal, has been filed under Part 157.

2. No penetration of the 8:1 surface in AC 150/5390-2 is permitted (see figure A-1). Penetrations of either A or B areas but not penetrations of both areas are allowed if the obstructions are charted, and marked or lighted and if not considered a hazard. Use formula A-1 to determine height of the 8:1 surface.

Figure A-1. 8:1 Surface in AC 150/5390-2.



Formula A-1. 8:1 OCS height (S_H).

$$S_H = (r + HE) \cdot e^{\frac{D}{8r}} - r$$

Where:

D = C/L distance FATO edge to Obstacle

HE = Heliport Elevation

(r+HE)*e^(D/(8*r))-r

Calculator		
D (ft)		Click here to calculate
HE		
S_H		

3. An acceptable onsite evaluation of the heliport for VFR use is required. Order 8700.1, General Aviation Inspector’s Guide, chapter 61 is to be used for evaluation of the heliport. Based on the FAA determination, a procedure can be developed under the following conditions:

a. No objection.

b. Conditional. Conditions have been resolved by the proponent, e.g., obstacle penetrations of the 8:1 approach area, transitional and lateral extension areas, or pertain to the minimum size of the FATO, TLOF, and Safety Area.

c. Objection. If an objection determination is issued, an IVH approach procedure is not authorized to be developed. A Point-in-Space (PinS) (Proceed VFR) approach procedure may be developed in accordance with chapter 5, paragraph 7.

4. An acceptable evaluation of the visual segment for flyability, obstacles, and visual references must be completed in both day and night flight conditions. The heliport or heliport visual references must be in clear view at the MAP, e.g., it cannot be completely obscured behind a building. A heliport is the area of land, water or a structure used or intended to be used for the landing and takeoff of helicopters, together with appurtenant buildings and facilities. Buildings and facilities associated with the heliport such as hangers, administration buildings, AWOS equipment, windsock, beacon, etc. located within 500 ft are acceptable visual references. Surrounding buildings and land marks are not allowable visual references, unless approved by Flight Standards. At least one of the following visual references must be visible or identifiable before the pilot may proceed visually:

a. FATO or FATO lights.

b. TLOF or TLOF lights.

c. Heliport Instrument Lighting System (HILS).

d. Heliport Approach Lighting System (HALS) or lead-in lights.

e. Visual Glideslope Indicator (VGSI).

f. Windsock or windsock light(s).*****

g. Heliport beacon.*

h. Other facilities or systems approved by Flight Standards (Flight Technologies and Procedures Division)).

***Note:** Windsock lights and heliport beacons should be located within 500 ft of the TLOF.

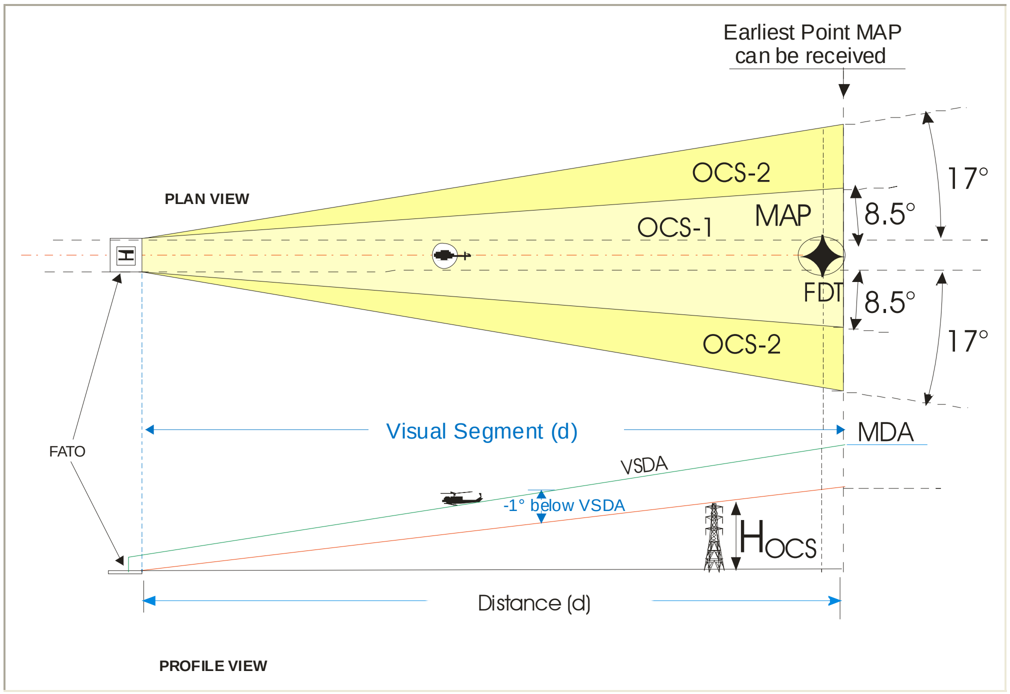
5. IFR Approach to a VFR Heliport (IVH) Analysis. The following analysis must be performed for authorizing an IVH procedure. Obstacle clearance surface (OCS) areas are applied using concepts from Order 8260.3, Volume 1, chapter 2, paragraph 251a (1) with the following exceptions:

a. **Alignment is always** centered on the visual segment centerline.

b. Length OCS-1 and OCS-2. The length of OCS-1 and OCS-2 begin from the edge of the FATO and extend to abeam the earliest point the MAP can be received (see figure A-2).

c. Area Width OCS-1 and OCS-2. OCS-1 splays outward 8.5 degrees from the outer edges of the FATO. OCS-2 splays outward 17 degrees from the outer edges of the FATO (see figure A-2).

Figure A-2. OCS for IVH Procedures.



Step 1: Calculate OCS-1 width (W_{OCS-1}) at distance (d) from the FATO edge using the formula A-2.

Formula A-2. OCS-1 Width (W_{OCS-1})		
$$W_{OCS-1} = \left[\tan\left(8.5^{\circ} \bullet \frac{\pi}{180}\right) \bullet d\right] + .5 \bullet F_W$$ Where: W_{OCS-1} = Perpendicular distance from the flight path to the edge of the OCS-1; d = Distance (ft) from the FATO edge measured along the flight path; F_W = FATO width		
[(tan(8.5*π/180)*d]+0.5*F_W		
Calculator		
d		Click here to calculate
F_W		
W_{OCS-1}		

Step 2: Calculate the OCS-2 width (W_{OCS-2}) at distance (d) from the FATO edge using the formula A-3.

Formula A-3. OCS-2 Width (W_{OCS-2})		
$$W_{OCS-2} = \left[\tan\left(17^{\circ} \frac{\pi}{180}\right) \bullet d\right] + .5 \bullet F_W$$ Where: W_{OCS-2} = Perpendicular distance from the flight path to the edge of the OCS-2; d = Distance (ft) from the FATO edge measured along the flight path; F_W = FATO width		
[(tan(17*π/180)*d]+0.5*F_W		
Calculator		
d		Click here to calculate
F_W		
W_{OCS-2}		

The slope of OCS-1 and OCS-2 is equal to the visual segment descent angle (VSDA) minus 1 degree measured from the FATO edge MSL elevation. Use formula A-4 to determine the MSL height of OCS-1 and OCS-2 at distance (D) from the FATO edge:

Formula A-4. OCS-1 and OCS-2 Slope (H_{OCS})

$$H_{OCS} = (r + HE) \bullet e^{\frac{D[\tan((VSDA-1)\cdot\frac{\pi}{180})]}{r}} - r$$

Where:

VSDA - 1= (VSDA minus 1 degree)
H_{ocs}= OCS-1 and OCS-2 MSL height
D = Distance (ft), FATO edge to obstacle
HE = Heliport/FATO edge elevation (MSL)

(r+HE)*e^(D*[tan((VSDA-1)*π/180)]/r)-r

Calculator

D		Click here to calculate
VSDA	°	
HE		
H_{OCS}		

d. If an unlighted obstacle penetrates OCS-1, a VGSI is required to be installed at the heliport.

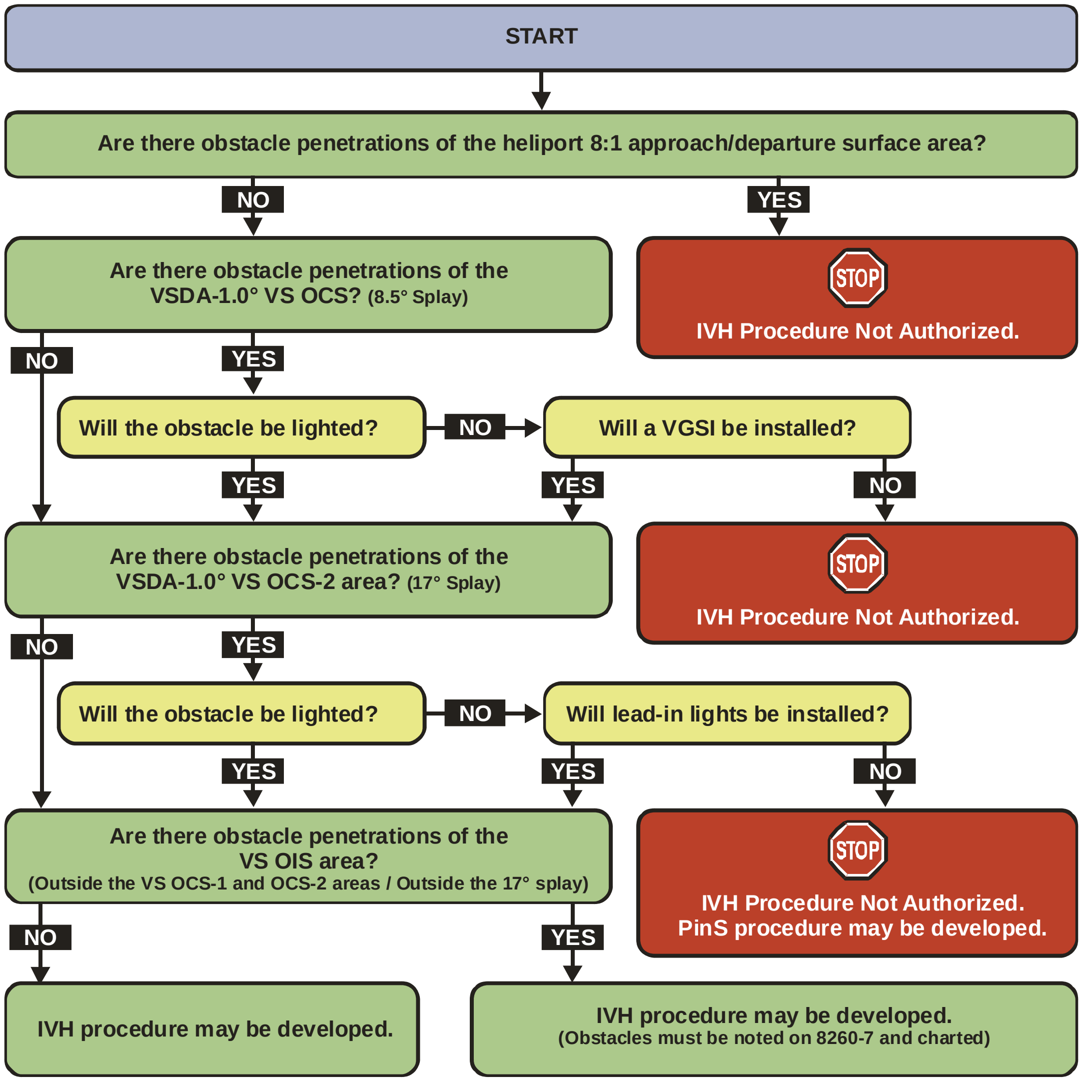
e. If an unlighted obstacle penetration is outside of OCS-1 but within OCS-2, the heliport must have lead-in lights to provide the pilot the visual cues to remain within the IVH OCS area.

f. The operational suitability of the lead in lights must be evaluated in accordance with appendix A, paragraph 4, during the night evaluation.

g If there are obstacle penetrations outside of the OCS-1 and OCS-2 areas but within the OIS area (see chapter 5, paragraph 5**,** these obstacle penetrations must be noted on 8260-7 and charted.

6. If any of these conditions are not met, a PinS (Proceed VFR) procedure may be developed in accordance with chapter 5, paragraph 7 (see figure A-3).

Figure A-3. IVH (Proceed Visually) versus PinS (Proceed VFR).



Appendix B. Administrative Information

1. Distribution. This order is distributed in the Offices of Airport Safety and Standards and Communications, Navigation, and Surveillance Systems; Air Traffic Organization, Flight Standards Services offices, and Airports Divisions; special mailing list ZVS-827, and to Special Military and Public Addressees.

2. Background. The analysis of Global Positioning System/Wide Area Augmentation System (GPS/WAAS) navigation flight test data provides the basis for these criteria. A significant difference exists between approach procedures to runways and approach procedures to heliports. Approaches to runways terminate in relatively obstacle-free environments. Approaches to heliports commonly terminate in areas of dense population and large buildings. Speed limitations incorporated in these criteria provide the smallest obstacle clearance areas, the shortest segment lengths, and the lowest ceiling and visibility minimums. The graphic illustrations in this order are not to scale. The guidance published in this directive supersedes previous guidance concerning helicopters published in Terminal Instrument Procedures (TERPS) Instruction Letters (TILs) and other correspondence.

3. Definitions.

a. Approach Procedure Types using RNAV (GPS).

(1) IFR to an IFR Heliport (Public and Special). An IFR approach to a heliport that meets Advisory Circular (AC) 150/5390-2, Heliport Design, standards for an IFR heliport.

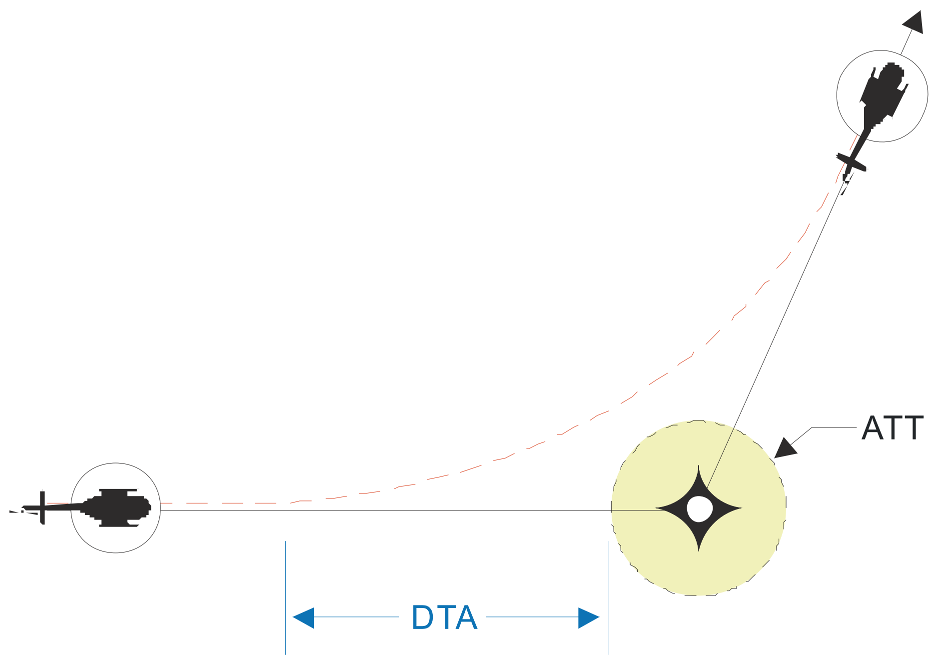
(2) IVH (Proceed Visually) (Special). An IFR approach to a VFR heliport that meets AC 150/5390-2 standards. This procedure requires flight standards approval. The phrase "Proceed Visually" is charted on the procedure for the visual segment from the MAP to the heliport. IVR applies IVH criteria to an approach to a VFR runway.

(3) Point-in-Space (PinS) Approach (Proceed VFR) (Public and Special). An IFR PinS approach to one or more VFR heliports. The phrase "Proceed VFR" is charted on the procedure for the VFR segment following the MAP.

(4) IFR to a Runway (Public and Special). An IFR helicopter approach procedure to a runway.

b. Distance of Turn Anticipation (DTA). DTA represents the maximum distance prior to a fly-by-fix that a helicopter is expected to start a turn to intercept the course of the next segment. The along-track tolerance (ATT) value, associated with a fix, is added to the DTA value when DTA is applied (see figure B-1 and formula 2-6).

Figure B-1. Distance of Turn Anticipation (DTA)



DTA = Radius x tan (degrees of turn ÷ 2)

c. Fly-By Fix. A fly-by fix is a waypoint where a turn is initiated prior to reaching it.

d. Fly-Over Waypoint (WP). A fly-over WP is a waypoint over which an aircraft is expected to fly before one turn is initiated.

e. Final Approach and Takeoff Area (FATO). A defined area over which the final phase of the approach to a hover, or a landing, is completed and from which the takeoff is initiated. The guidance for a FATO is published in AC 150/5390-2.

f. Fictitious Helipoint (FHP). The FHP is located 2,600 ft beyond the MAP and 9,023 ft in front of the flight path alignment point (FPAP). It is used to establish the approach course width for the WAAS.

g. Flight Path Alignment Point (FPAP). The FPAP is a 3-dimensional (3D) point defined by World Geodetic System of 1984/North American Datum of 1983 (WGS-84/NAD-83) latitude, longitude, mean sea level (MSL) elevation, and WGS-84 Geoid height. The FPAP is used in conjunction with the FHP and the geometric center of the WGS-84 ellipsoid to define the final approach azimuth [localizer performance with vertical guidance (LPV) glidepath's vertical plane, where used) associated with a localizer performance (LP) or LPV final course.

h. Flight Technical Error (FTE). FTE is the measure of the pilot or autopilot's ability to control an aircraft so that its indicated position matches the desired position.

i. Global Navigation Satellite System (GNSS) Azimuth Reference Point (GARP). A calculated point 1,000 ft beyond the FPAP lying on an extension of a geodesic line from the landing threshold point/fictitious threshold point (LTP/FTP) through the FPAP. This point is used by the airborne system as the origin of the lateral guidance sector. It may be considered as the origin of an imaginary localizer antenna.

j. Geoid Height (GH). The GH is the height of the Geoid relative to the WGS-84 ellipsoid. It is a positive value when the Geoid is above the WGS-84 ellipsoid and negative when it is below. The value is used to convert a mean sea level (MSL) elevation to an ellipsoidal or geodetic height - the height above ellipsoid (HAE).

Note: The Geoid is an imaginary surface within or around the earth that is everywhere normal to the direction of gravity and coincides with MSL in the oceans. It is the reference surface for MSL heights.

k. Heliport Approach Lighting System (HALS). The HALS is a distinctive approach lighting configuration designed to prevent it from being mistaken for an airport runway approach lighting system. HALS consists of ten bars of lights at 100-ft increments and has a length of 1,000 ft (305 m). HALS provides a visibility credit of 1/4 statute mile (SM) for nonprecision approaches.

l. Height Above Landing Area Elevation (HAL). The HAL is the height of the minimum descent altitude (MDA) above helipoint elevation.

m. Height Above Surface (HAS). HAS is the height of the MDA above the highest terrain/surface within a 5,200-ft radius of the MAP in the PinS procedure.

n. Helipoint Crossing Height (HCH). The HCH is the height of the vertical guidance path above the heliport elevation at the helipoint.

o. Helipoint. The helipoint is the aiming point for the visual segment and is normally centered in the touchdown and lift-off area (TLOF). The TLOF is normally centered in the FATO.

p. Heliport. An area of land, water, or structure used or intended to be used for helicopter landings and takeoffs and includes associated buildings and facilities. IFR and VFR heliports are described in AC 150/5390-2.

q. Heliport Elevation (HE). For heliports without a precision approach, the heliport elevation is the highest point of the FATO expressed as the distance above mean sea level (MSL).

r. Heliport Reference Point (HRP). The geographic position of the helipoint, measured at the center of the FATO or the central point of multiple FATOs, expressed as (WGS-84/NAD-83) latitude and longitude to the nearest hundredth of a second. The HRP elevation is equal to the heliport elevation.

s. Initial Departure Fix (IDF). The first fix on a PinS departure procedure where application of IFR obstruction protection and air traffic separation standards are provided.

t. IFR Heliports. Facility specifications for IFR Heliports are described in chapters 6 or 7 as appropriate of Advisory Circular 150/5390-2, Heliport Design. Chapter 6 of AC 150/5390-2 relates to paragraph 5.3 of this order for nonprecision IFR approach procedures to IFR heliports.

u. Landing and Takeoff Site. The area of intended landing and takeoff. It can be a heliport, helistop, vertiport, or other point of landing designated for a PinS approach.

v. Landing Threshold Point. The LTP is a 3D point at the intersection of the runway centerline and the runway threshold (RWT). WGS-84/NAD-83 latitude, longitude, MSL elevation, and geoid height define it. It is used in conjunction with the FPAP and the geometric center of the WGS-84 ellipsoid to define the vertical plane of an RNAV final approach course.

w. Proceed Visually. This phrase requires the pilot to acquire and maintain visual contact with the FATO or elements associated with the FATO such as heliport lighting, precision approach path indicator (PAPI), etc. at or prior to the MAP. Obstacle and terrain avoidance from the MAP to the FATO is the responsibility of the pilot. A missed approach procedure is not provided between the MAP and the landing FATO.

x. Proceed VFR. For PinS procedures, this phrase requires the pilot to proceed from the MAP to the selected landing area on the approach chart with no less than the visibility and ceiling required on the approach chart. For flights that do not terminate at the selected landing area on the approach chart, the pilot is required to proceed from the MAP under the applicable VFR for ceiling and visibility required by the applicable Title 14 Code of Federal Regulations (14 CFR) but no less than the visibility required on the approach chart, operations specifications (OpsSpec), or letter of agreement (LOA). The pilot is responsible for obstacle and terrain avoidance from the MAP to the landing site. A missed approach procedure is not provided between the MAP and the landing site. The landing site is not required to be in sight from the MAP.

y. Reference Datum Point (RDP). The RDP is a 3D point defined by the LTP or FTP latitude/longitude position, MSL elevation, and a threshold crossing height (TCH) value. The RDP is in the vertical plane associated with the final approach course and is used to relate the glidepath angle of the final approach track to the landing runway.

z. Touchdown and Lift-Off Area (TLOF). A TLOF is a load bearing, generally paved area, normally centered in the FATO, on which the helicopter lands or takes off (see AC 150/5390-2).

aa. United States Air Force (USAF).

bb. United States Army (USA).

cc. United States Coast Guard (USCG).

dd. United States Navy (USN).

ee. VFR Heliports. Standards and recommendations for VFR and IFR heliports are described in chapters 2 through 5 and chapter 8 of AC 150/5390-2. Paragraph 5.4 of this order relates to VFR heliports.

ff. Minimum instrument meteorological condition airspeed (V_{mini}). V_{mini} means instrument flight minimum speed, utilized in complying with minimum limit speed requirements for instrument flight. This is the certified minimum airspeed that a specific helicopter is approved to enter instrument meteorological flight conditions.

gg. Visual Segment Descent Angle (VSDA). The angle of descent in the visual segment.

hh. Visual Segment Descent Point (VSDP). The descent point within the visual segment of a helicopter instrument approach to an IFR heliport or runway.

ii. Visual Segment Reference Line (VSRL). A line perpendicular to the final course at a distance of 75 ft (22.9 m) from the helipoint for public use heliports and 50 ft (15.27 m) from the helipoint for heliports with special instrument procedures. It extends 75 ft (22.9 m) on each side of the final course centerline for public use heliports and 50 ft (15.27 m) on each side of the final course centerline for heliports with special instrument procedures. For IFR procedures the line is 75 ft (22.9 m) from the helipoint and it extends 75 ft (22.9 m) on each side of the final approach course.

jj. Wide Area Augmentation System (WAAS) Localizer Performance (LP). The LP approach applies lateral-only WAAS guidance (and reduced OEA) within the FAS to a PinS.

4. Data Resolution. See chapter 2, paragraph 2.

5. Related Publications. All directives in this order refer to the latest editions:

a. Advisory Circular 150/5390-2, Heliport Design.

b. Order 7130.3, Holding Pattern Criteria.

c. Order 8260.3, United States Standard for Terminal Instrument Procedure (TERPS).

d. Order 8260.19, Flight Procedures and Airspace.

e. Order 8260.40, Flight Management System Instrument Procedures Development.

f. Order 8260.45, Terminal Arrival Area (TAA) Design Criteria.

g. Order 8260.54, United States Standards for Area Navigation (RNAV).

6. Information Update. For your convenience, FAA Form 1320-19, Directive Feedback Information, is included at the end of this order to note any deficiencies found, clarifications needed, or suggested improvements regarding the contents of this order. When forwarding your comments to the originating office for consideration, please use the “Other Comments” block to provide a complete explanation of why the suggested change is necessary.

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Directive Feedback Information

Please submit any written comments or recommendation for improving this directive, or suggest new items or subjects to be added to it. Also, if you find an error, please tell us about it.

Subject: Order 8260.42B, United States Standard for Helicopter Area Navigation

To: Directive Management Officer, ______________________________

(Please check all appropriate line items)

☐ An error (procedural or typographical) has been noted in paragraph ________ on page ____________ .

☐ Recommend paragraph ________ on page ____________ be changed as follows: *(attached separate sheet if necessary)*

☐ In a future change to this order, please include coverage on the following subject *(briefly describe what you want added):*

☐ Other comments:

☐ I would like to discuss the above. Please contact me.

Submitted by: ______________________________ Date: ______________

Telephone Number: ______________________ Routing Symbol: ________________