PART 3. AIRPORT OBSTRUCTION CHART SURVEYS

CHAPTER 11. INTRODUCTION

The Airport Obstruction Chart (See figure 3-1) (AOC) survey is an extensive field/remote sensing operation, providing aeronautical and other information to support a wide range of National Airspace System (NAS) activities. AOC surveys provide source information on—

- Runways/stopways
- Navigational aids (NAVAIDs)
- 14 CFR Part 77 obstructions
- Aircraft movement and apron areas
- Prominent airport buildings
- Selected roads and other traverse ways
- Cultural and natural features of landmark value
- Miscellaneous and special request items

AOC surveys also establish (if it does not exist already) geodetic control in the airport vicinity based on permanent survey marks accurately connected to the National Spatial Reference System (NSRS) in accordance with AC 150/5300-16, *General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey*. This control and the associated NSRS connection assures accurate relativity between surveyed points on the airport and between these points and other surveyed points in the NAS, including navigation satellites.

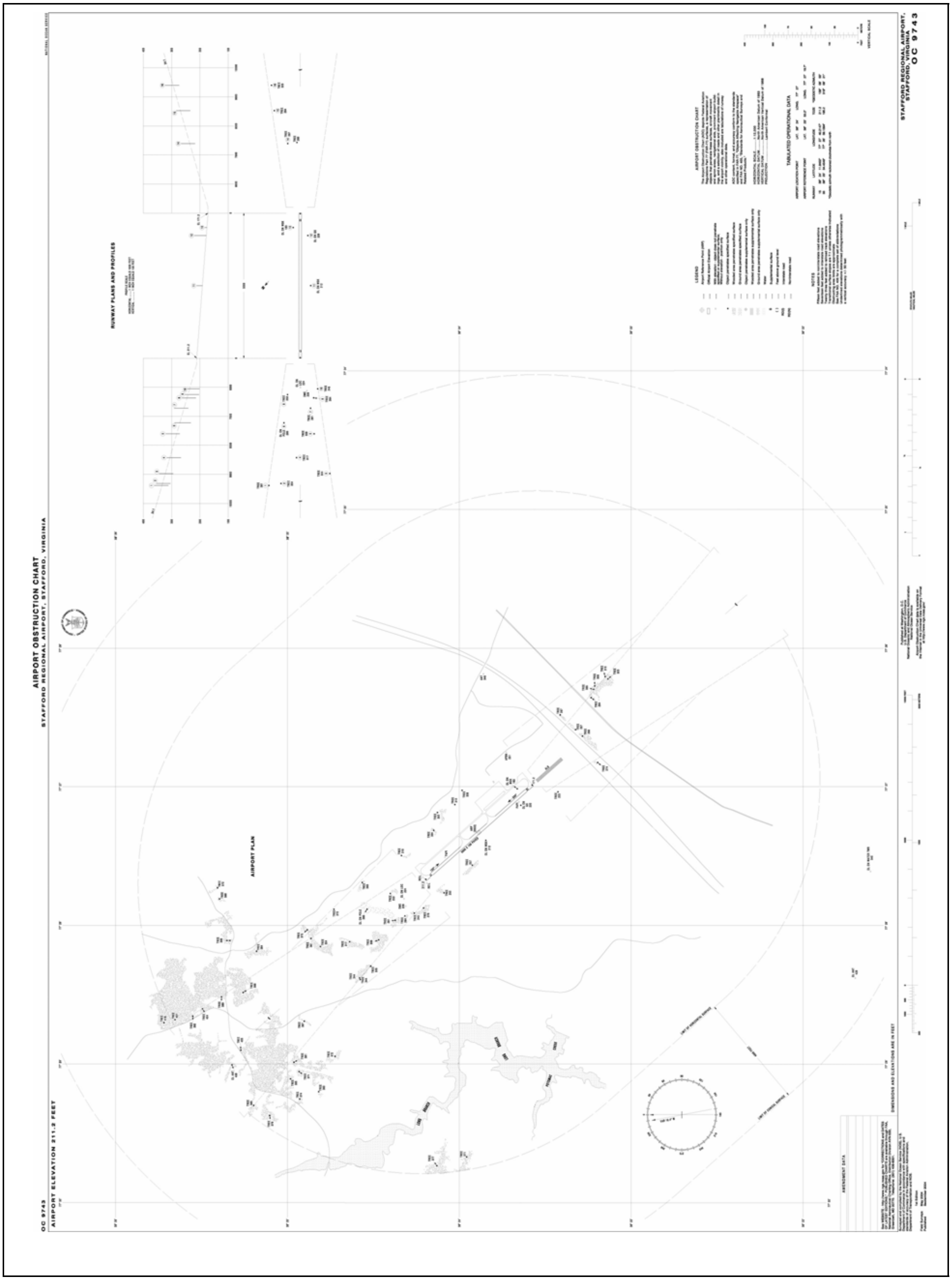


Figure 3-1: Illustrates a typical Airport Obstruction Chart

AOC survey data is used to—

- Develop instrument approach and departure procedures
- Determine maximum takeoff weights for civil aircraft
- Certify airports for certain types of operations, including 14 CFR Part 139
- Update official U.S. Government aeronautical publications
- Provide geodetic control for engineering projects related to runway/taxiway construction, NAVAID sighting, obstruction clearing, road building, and other airport improvement activities
- Assist in airport planning and land use studies in the airport vicinity
- Support miscellaneous activities, such as aircraft accident investigations and special one-time projects

Standards for AOC survey products are described in detail in Chapter 18. Unless otherwise stated, all data provided in accordance with this part must be current at the time of the AOC field survey.

CHAPTER 12. DATUM TIE AND LOCAL CONTROL

Surveys accomplished in accordance with these standards must be tied to the NSRS. Reference determined positions to the North American Datum of 1983 (NAD 83), which is operationally equivalent to and may be used as World Geodetic System of 1984 (WGS 84) values for charting and navigation purposes. Refer to http://www.ngs.noaa.gov/faq.shtml#Transform for clarification of WGS 84 conversions. Reference orthometric heights (MSL elevations) to the North American Vertical Datum of 1988 (NAVD 88).

CHAPTER 13. RUNWAY AND STOPWAY POINTS

Runway location and orientation are paramount to airport safety, efficiency, economics, and environmental impact. This section provides guidance on the location and marking of runway/stopway ends as well as the determination of profile points along the runway. It is extremely important that the runway ends are properly selected, since runway lengths and azimuths are determined from the established positions of the ends. Aircraft safety during takeoff and landing as well as airfield restrictions is dependent upon accurate information derived from the survey of runway ends. The identification of certain points (positions and elevations) along the runway is critical for landings, take-offs, and navigation. (Refer to Appendix 2, Section 2-4, Runway, Stopway, and Displaced Threshold End Identification.)

13-1. DESCRIPTION

Provide runway/stopway data for all runways and stopways with a specially prepared hard surface (SPHS) existing at the time of the field survey. Provide the data for non-specially prepared hard surface (non-SPHS) runways/stopways existing at the time of the field survey if—

- They are depicted in the version of the U.S. Government flight information publication *U.S. Terminal Procedures* current at the time of the field survey,
- The runway/stopway was specially requested by appropriate FAA authorities, or
- The stopway was officially designated a stopway by appropriate airport authorities.

Important points to bear in mind about stopways:

- A stopway is an area beyond the runway, with sufficient strength to support a decelerating aircraft in all weather conditions. It is not a runway safety area.
- A stopway must be designated as such. This means the airport owner/operator determines that a stopway exists and commits to maintaining the area as a stopway, including the appropriate lighting.
- The existence of a stopway means that the runway has a declared accelerate/stop distance, even though it may not be published.

Unless otherwise stated, all runway/stopway points must be on the runway/stopway centerline. Refer to Appendix 2, Section 2-4, Runway, Stopway, Displaced Threshold, End Identification, for detailed descriptions. The number painted on the runway at the time of the field survey must identify runways. Use the runway number published in *U.S. Terminal Procedures* (version current at the time of the field survey) if a number is not painted on the runway.

13-2. RUNWAY LENGTH AND WIDTH

Runway length does not include blast pads or stopway surfaces located at one or both ends of a runway; however, the displaced threshold is included in the physical length of the runway. When the ends of the runway surface have been determined, mark the positions (nail and washer, chisel square, or paint if possible) with a distinctive inscription to ensure future identification. In the runway end sketch, specify the inscription method used.

Runway lengths are determined from the positions of the runway ends. Determine the runway end positions using GPS methodologies. Compute runway lengths using the Aeronautical Data Collection and Analysis Tool (ADCAT) software. Compute the runway(s) length at the airport and compare the computed length(s) to the lengths published in the Airport Facility Directory. If the computed length, rounded to the nearest foot, is shorter than the published length and the difference cannot be attributed to a runway change, the points identified as the runway ends should be reviewed with the airport authority.

Measure the runway width from the outer edge of the runway, excluding runway shoulders and stopways. The narrowest section of runway should be measured. (Refer to Appendix 2, Section 2-4, Runway, Stopway, Displaced Threshold, End Identification.)

The runway width is the physical width extending over the entire length of the rectangle. Runway widths should be measured to the nearest tenth of a foot (0.1 ft) and the dimension included on the runway end sketch. Discuss the determined runway and associated displaced threshold, stopway, and blast pad dimensions with the airport manager or designated representative and resolve any disagreements or discrepancies in the values before departing the site.

13-3. REQUIRED RUNWAY DATA

Required data for SPHS and non-SPHS runways and stopways are presented in the table below and Figure 3-2.

Table 3-1: Required runway and stopway data

Runway/Stopway Point	Required data							
	SPHS Runway				Non-SPHS Runway			
	Lat	Lon	Elev	Dist	Lat	Lon	Elev	Dist
Airport Elevation			✓	✓[1]			✓	✓[1]
Runway Ends	✓	✓	✓		✓	✓	✓	
Intersection of SPHS Runways			✓	✓[2]				
Displaced Thresholds	✓	✓	✓		✓	✓		
Touchdown Zone			✓					
Stopway Ends			✓	✓[3]			✓	✓[3]
Supplemental Profile Points			✓	✓[2]				
Point Abeam Glideslope	✓	✓	✓					
Point Abeam MLS Elevation Antenna	✓	✓	✓					
Point Abeam Offset Localizer	✓	✓						
Point Abeam Offset LDA	✓	✓						
Point Abeam Offset SDF	✓	✓						
Point Abeam Offset MLS Azimuth	✓	✓						
Note:	When an obstruction survey is performed on a runway with a Non-SPHS the required runway/stopway data will be the same as for a SPHS runway. The touchdown zone elevation is required only for SPHS runways with a landing length equal to or greater than 3,000 feet. A facility is considered offset if located more than 10 feet from the runway centerline/centerline extended.							
Distance:	Distance from runway's— [1] Near end for airport elevation [2] Approach end for runway intersections and supplemental profile points [3] Stop end for stopways							
A facility is considered offset if located more than 10 feet from the runway centerline/centerline extended.								

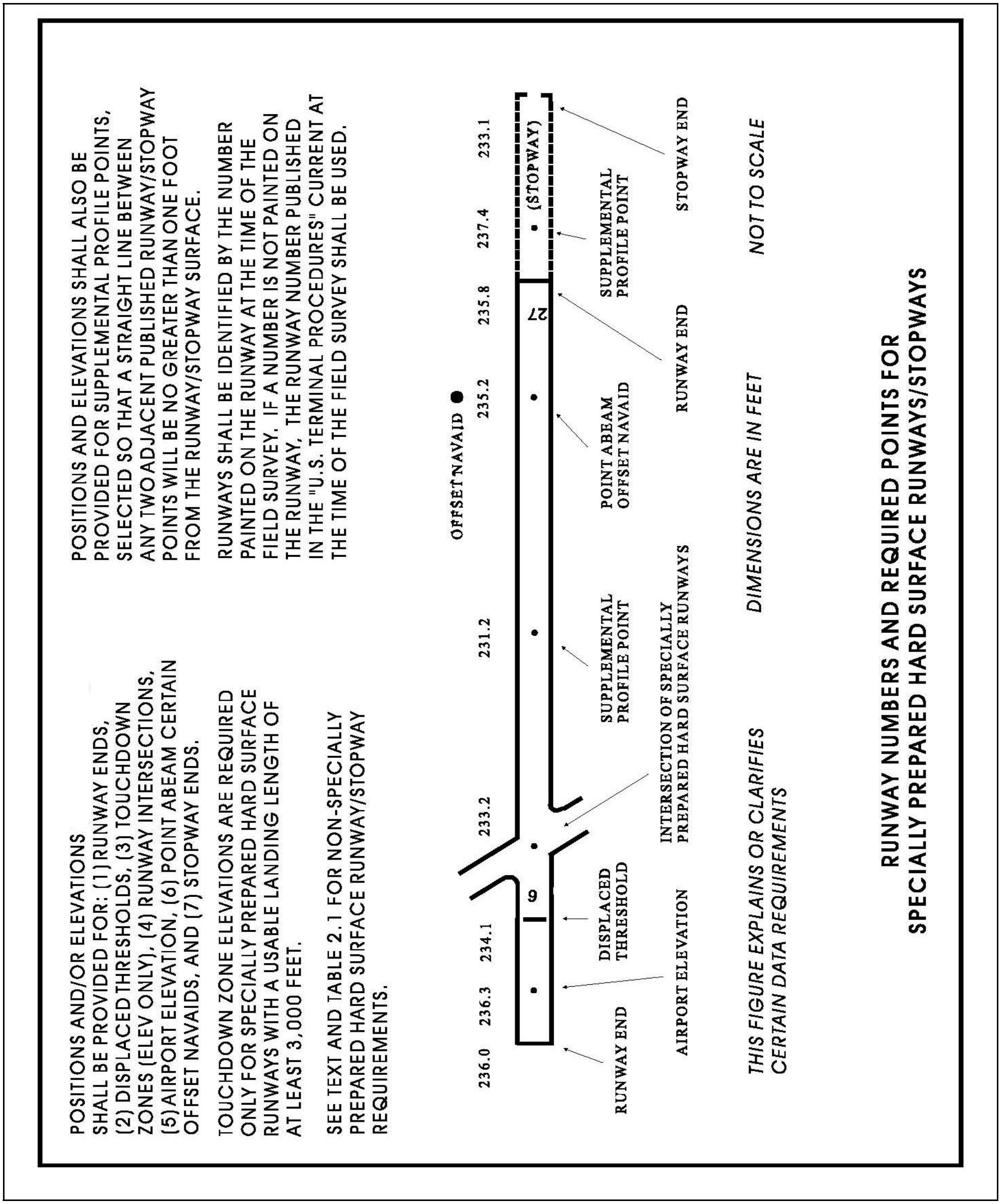


Figure 3- 2: Illustrates the runway numbers and required points for specially prepared hard surface runways/stopways

13-4. REQUIRED ACCURACIES FOR RUNWAY/STOPWAY DATA TABLE

Table 3-2: Runway and stopway data accuracy requirements

Item (Values are in Feet)	Horizontal	Vertical	Ellipsoid
Physical End	1.00	0.25	0.20
Displaced Threshold	1.00	0.25	0.20
Threshold Zone Elevation (TDZE)	N/A	0.25	0.20
Intersection of SPHS Rwys	20.00	0.25	0.20
Supplemental Profile Points	20.00	0.25	0.20
Point Abeam GS	1.00	0.25	0.20
Point Abeam MLSEL	1.00	0.25	0.20
Point Abeam Offset LOC	1.00	N/A	N/A
Point Abeam Offset LDA	1.00	N/A	N/A
Point Abeam Offset SDF	1.00	N/A	N/A
Point Abeam Offset MLSAZ	1.00	N/A	N/A
Stopway Length	2.00	N/A	N/A
Stopway End	N/A	0.25	0.20
Airport Elevation	20.00	0.25	0.20

13-5. RUNWAY/STOPWAY PROFILE

Positions and elevations (on the runway centerline) are required at certain marked points abeam various NAVAIDs and at intermediate points along the runway to establish the elevation of the airport and to define the gradients of the runway.

Runway/stopway profiles may be obtained from GPS observations (static, kinematic, and/or real-time kinematic) or from spirit level/EDM observations. In either case, profiles must begin and end on the runway end points. If GPS is used to determine runway profile, data will be collected twice. If GPS is collected while in motion (i.e. kinematic and/or real-time kinematic GPS) the following requirements apply:

(1). A minimum of five satellites will be used.
(2). Collect one data set in each direction; each data set will be a separate file.
(3). Collect elevations and positions every 50 feet or less along the runway, and interpolate the required intermediate points.
(4). Mean the two data sets.
(5). Provide a graph displaying the two collects. All points will meet the accuracies as stated in Table 3-2.

(6). If a static or a "Stop and Go" GPS technique is used, the following requirements apply:

- A minimum of five satellites will be used.
- Positions and elevations will be collected for all required points (refer to Table 3-1 above).
- Point spacing will be no greater than 600 feet.
- Any points of apparent change in grade are required.
- All points will be collected twice; each data set will be a separate file.
- Mean/average the two data sets.
- Provide a graph displaying the two collects.
- Provide a sketch showing the location of the profile points.
- All points will meet the accuracies as stated in Table 3-2.

(7). If spirit levels are used to collect elevations and positions, the following requirements apply:

- All spirit leveling will be run forward and backward or run in a closed loop.
- The spirit leveling will be referenced to a high accuracy benchmark or the PACS, SACS, or temporary survey mark (TSM). Include at least two such reference elevations to ensure the required check to datum.
- Positions and elevations will be collected at all required points (refer to Table 3-1 above).
- Point spacing will be no greater than 600 feet.
- Any points of apparent change in grade are required.
- Submit a graph displaying the collected data.
- Provide a sketch showing the location of the profile points.
- All points will meet the accuracies as stated in Table 3-2.

13-6. PHOTOGRAPHS AND SKETCHES

Three digital photographs must be taken, as described in below, of all survey nails and washers (those marking runway ends and thresholds).

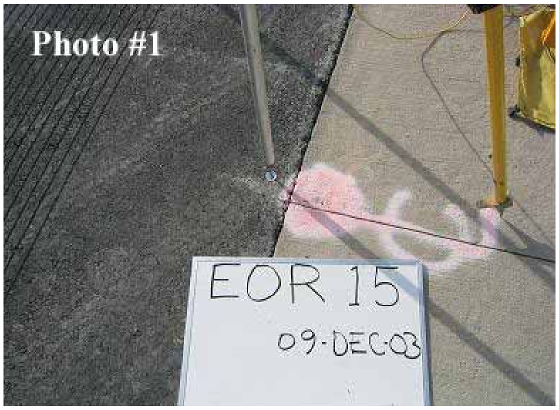


Figure-3-3: Photograph Type #1 (Eye Level). Photo taken from above the mark, showing an area around the mark about 1 meter in diameter.

Figure 3-4: Photograph Type #2 (Approach). Photo showing tripod over the mark in foreground and approach in the background.

Figure 3-5: Photograph Type #3 (Across Runway). Photo taken from the side of the runway looking across the end of the runway, with a tripod or arrow indicating the end point; include any features used to identify the runway end.

Figure 3-6: Signs should be put in photograph types #1 through #3 showing the runway end designation (name) in large and clearly printed letters. In photograph #3, the cardinal direction (N, NE, etc.) in which the camera is pointed should be included.

CHAPTER 14. DIGITAL PHOTOGRAPH AND FILE NAMING CONVENTIONS

14-1. NAMING CONVENTION

Use the following file naming convention: the airport designator, runway end designator, photo number, and date, followed by the file type extension, as in the example below. Separate each section of the file name with an underscore—except the photo number, which should be preceded by a dash.

Sample File Name

For runway end point:	LAX_CL_END_RWY_12R-3_04MAY2001.jpg

For the runway end example, “LAX”=location identifier, “CL END RWY 12R”=runway end designator [CL=centerline, END=end, RWY= runway, 12=runway number, and R=right (or C=center, or L=left)], dash, “3”= photo number, and date.

14-2. CAPTION

Provide a caption for each photograph. The caption should include the following information:

- Airport location identifier (LID)
- Runway end designator
- Photo number
- Date the photo was taken

For example, LAX, 12R, 3, 23 Aug 2004. In addition, the caption for photo #2 will include the cardinal direction (N, NE, E, SE, etc.) the camera is pointing.

14-3. SKETCHES

The contractor will complete the following tasks.

- Make a sketch of all runway ends, stopways, and blast pads.
- A field sketch must contain a schematic diagram of the runway end, surface markings, lights, connecting taxiways, stopways, blast pads, and other information.
- Clearly annotate all pertinent lengths and distances on runway end sketches.
- The surveyor is responsible for verifying the information depicted, including all lengths and distances.
- Prepare a sketch of each runway. The sketch must include dimensions and explanations necessary to clarify any possible ambiguities between the actual runway surface and the runway as it appears on the photograph or sketch.

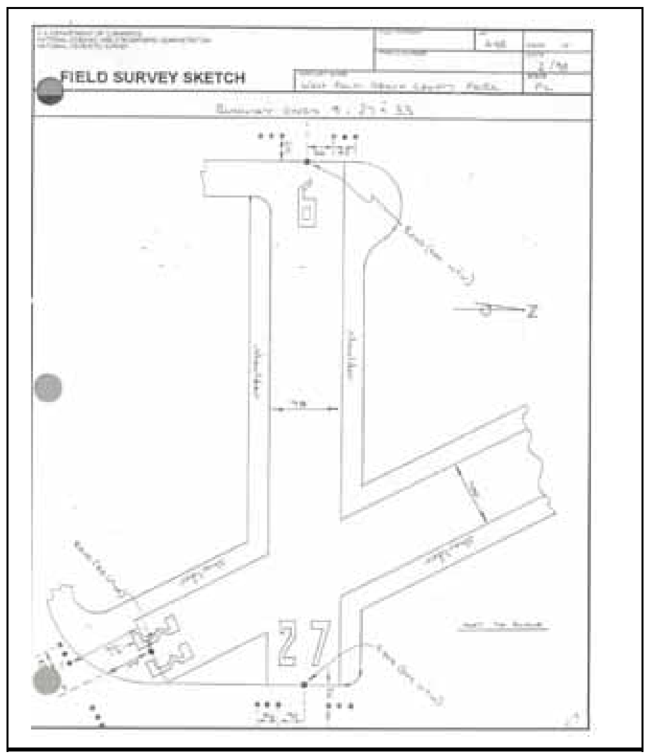


Figure 3-7: Illustrates a prepared sketch of each runway end at an airport

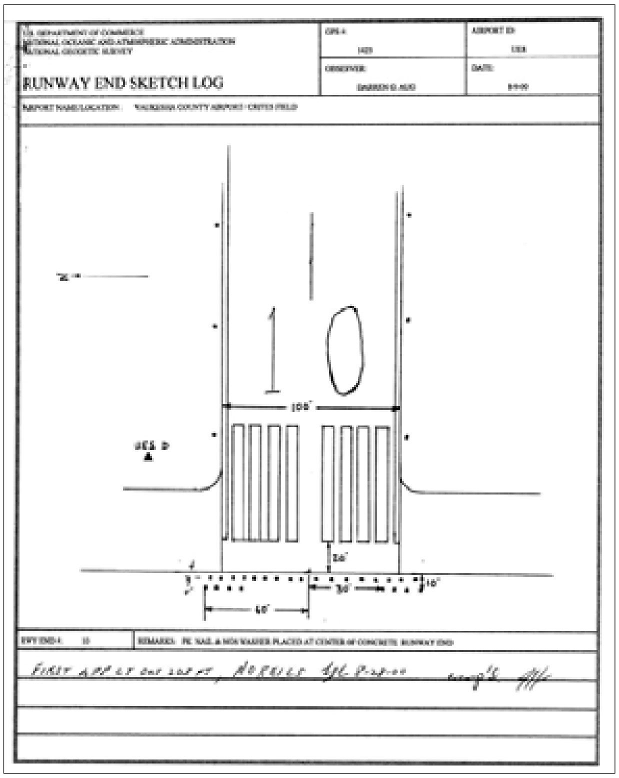


Fig 3-8: Illustrates the proper method of depicting a specific runway end

- On the sketch show the usable portion of the surfaced runway if it differs from the surface extent of the runway in either length or width. Consult the airport manager or other designated representative of the airport authority when making this determination.
- The sketch also needs to show the dimensions of any area near or off the runway end designated as "blast pad" or "stopway". Discuss with the airport authorities the definition, use, and designation of these areas if it is unclear.
- Show dimensions and measurements to clarify the relationship of such areas to the physical end of the runway if these areas do not exist.
- Clarify the sketch with notes and dimensions to identify discrepancies between the physical runway ends as they exist on the ground and as they appear on the imagery.
- Depict the runway numbers painted on the runways in the sketch. Show the approximate relationship between the runway number and the runway end threshold point on the sketch.
- Date each sketch and include the line painted under the runway number if it exists. It should be noted if numbers are not painted on the runway. Additional examples of airports sketches are available for reference in Appendix 2, Section 2-3.

CHAPTER 15. NAVIGATIONAL AIDS

An integral part of the airport system is the visual and electronic navigational aids (NAVAIDs) to assist pilots in navigating both on the airport and en route. A NAVAID is any visual or electronic device, airborne or on the surface, providing point-to-point guidance information or position data to aircraft in flight. FAA operates over 4,000 ground-based electronic NAVAIDs, each broadcasting navigation signals within a limited area. FAA also provides a variety of approach lighting systems to assist the pilot in transitioning from instrument reference to visual reference for landing. A NAVAID survey is the process of determining the position and/or elevation of one or more NAVAIDs and adjunctive points on associated runways or runway centerlines extended. A NAVAID survey may be combined with other aeronautical surveys, or it may be entirely independent. For certain electronic and visual NAVAIDs, the position of the established horizontal survey point must be determined. The horizontal survey point may be determined by either field survey or remotely sensed means. The horizontal survey point may be the center of the NAVAID or, when the NAVAID is composed of more than one unit, the center of the array. A position is required if, and only if, the NAVAID is associated with the airport being surveyed. If the NAVAID is also an obstruction, the obstruction requirements and accuracies also apply.

Survey data is required for NAVAIDs meeting all of the following three criteria:

- The NAVAID is listed in Table 3-3 below.
- The NAVAID is located within 10 nautical miles of the Airport Reference Point. See Appendix 2, Section 2-1, Airport Reference Point Computation.
- The NAVAID is associated with an instrument approach procedure for the airport being surveyed and the procedure is published in the version of the U.S. Government flight information publication *U.S. Terminal Procedures* current at the time of the field survey.

In addition to the NAVAIDs identified above, Airport Surveillance Radars and Air Route Surveillance Radars located within 14 CFR Part 77 limits for the airport being surveyed, and not located on a military aerodrome, must be surveyed. For any NAVAID off the airfield, a sketch is required, with dimensions, showing the NAVAID and its compound (area) and the point surveyed. Table 3-4 identifies what data must be collected and reported for each type of NAVAID. If a NAVAID is encountered that is not listed, contact the FAA Airport Surveying–GIS Program Manager for guidance.

15-1. ELECTRONIC NAVAIDS

Determine the position (and sometimes the elevation, depending on the NAVAID) for electronic NAVAIDs associated with the airport. The accuracy requirements for electronic NAVAIDs vary; refer to Table 3-3, Navigational Aids, for the required accuracy of the NAVAID being surveyed.

15-2. VISUAL NAVAIDS

To enhance visual information during the day when visibility is poor and at night, it is essential to provide visual aids that are as meaningful to pilots as possible. These aids provide visual clues to the pilot about the aircraft’s alignment and height in relation to the airport or runway. Visual NAVAIDs consist of a variety of lighting and marking aids used to guide the pilot both in the air and on the ground. Determine the position of the horizontal survey point for the visual aids as defined in Table 3-3. The position of the horizontal survey point may be the center of the NAVAID, the center of the unit array when the NAVAID is composed of more than one unit, or, in the case of approach light systems, the first and last lights.

Table 3-3 lists the Horizontal Survey Point (HSP), Vertical Survey Point (VSP), and accuracy requirements for the electronic and visual NAVAIDS normally found on and around airports. The accuracy values are in feet and are relative to the nearest PACS, SACS, or TSM. Paragraph 15-3 provides sample images of most typical NAVAIDs. These images depict the horizontal and vertical survey points for each of the identified NAVAIDs.

Table 3-3: Navigational Aids

ELECTRONIC NAVAIDS					
NAVAID	Horizontal Survey Point (HSP)	Vertical Survey Point (VSP)	Vertical		
			HORZ	ORTHO	ELLIP
Air Route Surveillance Radar (ARSR)	**(1)**	**(2)**	20.00 **(5)**	100.00	100.00
Airport Surveillance Radar (ASR)	**(1)**	**(2)**	20.00 **(5)**	10.00	10.00
Distance Measuring Equipment (DME):	Center of Antenna Cover	Center of Antenna Cover	1.00	1.00	1.00
Frequency Paired with LOC **(3)**	Center of Antenna Cover	Center of Antenna Cover	1.00	1.00	1.00
Frequency Paired with MLSAZ **(3)**	Center of Antenna Cover	**(2)**	20.00 **(5)**	20.00	20.00
Frequency Paired with NDB	Center of Antenna Cover	**(2)**	20.00 **(5)**	20.00	20.00
Frequency Paired with VOR Not Frequency Paired	Center of Antenna Cover	**(2)**	20.00 **(5)**	20.00	20.00
Fan Marker (FM)	Center of Antenna Array	**(2)**	20.00 **(5)**	20.00	20.00
Localizer (LOC) **(4)**	Center of Antenna Supporting Structure	**(2)**	1.00	1.00	1.00
Glide Slope (GS)	Center of Antenna Supporting Structure	**(2)**	1.00	0.25	0.20
End Fire Type (GS)	Phase Center Reference Point	Phase Center Reference Point	1.00	0.25	0.20
Inner Marker (IM)	Center of Antenna Array	**(2)**	20.00	20.00	20.00
Middle Marker (MM)	Center of Antenna Array	**(2)**	20.00	20.00	20.00
Outer Marker (OM)	Center of Antenna Array	**(2)**	50.00	20.00	20.00
Back Course Marker (BCM)	Center of Antenna Array	**(2)**	50.00	20.00	20.00

Table 3-3: Navigational Aids (continued)					
ELECTRONIC NAVAIDS					
NAVAID	Horizontal Survey Point (HSP)	Vertical Survey Point (VSP)	Vertical[5]		
			HORZ	ORTHO	ELLIP
Localizer Type Directional Aid (LDA)	Center of Antenna Supporting Structure	**(2)**	1.00	1.00	1.00
MLS Azimuth Guidance (MLSAZ)	Phase Center Reference Point	Phase Center Reference Point	1.00	1.00	1.00
MLS Elevation Guidance (MLSEL)	Phase Center Reference Point	Phase Center Reference Point	1.00	0.25	0.20
Non-directional Beacon (NDB)	Center of Antenna Array	**(2)**	20.00 **(5)**	20.00	20.00
Simplified Directional Facility (SDF)	Center of Antenna Supporting Structure	**(2)**	1.00	1.00	1.00
Tactical Air Navigation (TACAN)	Center of Antenna Cover	**(2)**	20.00 **(5)**	100.00	100.00
VHF Omni Directional Range (VOR)	Center of Antenna Cover	**(2)**	20.00 **(5)**	100.00	100.00
VOR/TACAN (VORTAC)	Center of Antenna Cover	**(2)**	20.00 **(5)**	100.00	100.00
VISUAL NAVAIDS					
Airport Beacon (APBN)	**(1)**	**(2)**	20.00 **(5)**	20.00	20.00
Visual Glide Slope Indicators	Center of Antenna Array	**(2)**	20.00	10.00	10.00
REIL	Center of Light	**(2)**	20.00	10.00	10.00
Approach Lights (ALS)	Center of first and last lights	**(2)**	20.00	10.00	10.00

Notes:

(1) The HSP will be the axis of antenna rotation if possible. If the antenna is covered, the HSP will be the center of the antenna cover.

(2) The VSP for these items will be the intersection of the ground, gravel, concrete pad, or other base and plumb line through the HSP. When access to this point is impractical, elevation of the VSP will be approximated.

(3) DME mid-point elevations are required only when the DME is frequency paired with an Instrument Landing System or Microwave Landing System.

(4) When LOC clearance and course array antennas are both present, only the course array antenna will be surveyed.

(5) The horizontal accuracy requirement for these items is 50 feet when not located on a public use airport or military field.

* A compass locator within 50 feet of an Instrument Landing System marker is considered collocated at the position of the marker. Other NAVAIDs are not considered collocated unless their HSPs are the same.

[5] When the navigational aid is an obstruction (penetrates an imaginary or obstruction surface), it must be surveyed to the accuracy standard as an obstruction, which might be higher.

Table 3-4: Electronic NAVAIDs					
NAVAID	NAVAID RWY &/or ID [6]	ABEAM POINT	LAT	LONG	ELEV
Air Route Surveillance Radar (ARSR)	ID	N/A	Y	Y	Y
Airport Surveillance Radar (ASR)	ID	N/A	Y	Y	Y
Distance Measuring Equipment (DME)	RWY#_ID	N/A	Y	Y	Y
Glide Slope (GS)	RWY#_ID	Y	Y	Y	Y
Glide Slope-End Fire type (GS)	RWY#_ID	Y	Y	Y	Y
Localizer (LOC)	RWY#_ID	Y	Y	Y	Y
Middle Marker (MM)	RWY#_ID	N/A	Y	Y	Y
Locator/Outer Marker (LOM/OM)	RWY#_ID	N/A	Y	Y	Y
Inner Marker (IM)	RWY#_ID	N/A	Y	Y	Y
Back Course Marker (BCM)	RWY#_ID	N/A	Y	Y	Y
Fan Marker (FM)	ID	N/A	Y	Y	Y
Localizer Type Directional Aid (LDA)	RWY#_ID	Y	Y	Y	Y
MLS Azimuth Guidance (MLSAZ)	RWY#_ID	Y	Y	Y	Y
MLS Elevation Guidance (MLSEL)	RWY#_ID	Y	Y	Y	Y
Non-Directional Beacon (NDB)	ID	N/A	Y	Y	Y
Simplified Directional Facility (SDF)	RWY#_ID	Y	Y	Y	Y
Tactical Air Navigation (TACAN)	ID	N/A	Y	Y	Y
VHF Omni Directional Range (VOR)	ID	N/A	Y	Y	Y
VOR/TACAN (VORTAC)	ID	N/A	Y	Y	Y

[6] Explanation and examples: ID – the facility lettered identifier i.e. ASR **[DDD]** and RWY#_ID – the runway end number (for which the facility serves) underscore the facility identifier: **LOM! (12_RTE).**

Table 3-5: Visual NAVAIDs					
NAVAID	NAVAID RWY &/or ID	ABEAM POINT	LAT	LONG	ELEV
Airport Beacon	NA	N/A	Y	Y	Y
ALS	RWY#	N/A	Y	Y	Y
REIL	RWY#	N/A	Y	Y	Y
VASI	RWY#	N/A	Y	Y	Y
PAPI	RWY#	N/A	Y	Y	Y
PLASI	RWY#	N/A	Y	Y	Y
PVASI	RWY#	N/A	Y	Y	Y
TVASI	RWY#	N/A	Y	Y	Y
TRCV	RWY#	N/A	Y	Y	Y
TDR	RWY#	N/A	Y	Y	Y

Note:
Visual NAVAIDs are associated with the runway end they serve; the Airport Beacon is an exception (i.e. ALS! (12); APBN).

15-3. NAVIGATIONAL AID HORIZONTAL AND VERTICAL SURVEY POINT REFERENCE INFORMATION

NAVIGATIONAL AID DESCRIPTION

Airport Beacon (APBN)

Airport Beacon is a visual navigational aid; they are used to guide pilots to lighted airports with a sequence of yellow, green, and/or white light. A beacon is normally operated from dusk until dawn. If the beacon is on during other hours it typically indicates that the airport is operating under instrument flight rules

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is located at the center of rotation axis. The no vertical survey point is required.

PHOTO

NAVIGATIONAL AID

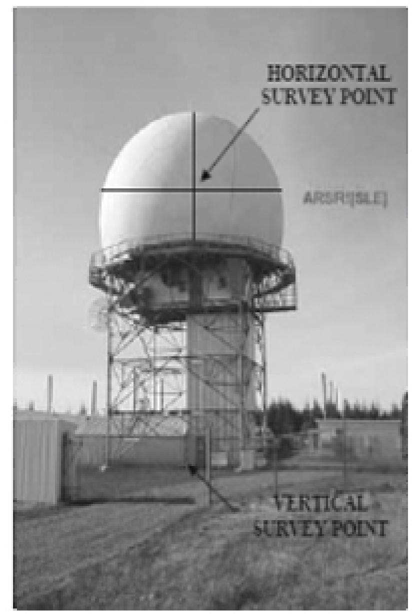
Air Route Surveillance Radar (ARSR)

The long-range radar equipment used in controlled airspace to manage traffic is the air route surveillance radar (ARSR) system. There are approximately 100 ARSR facilities to relay traffic information to radar controllers throughout the country. Each air route surveillance radar site can monitor aircraft flying within a 200-mile radius of the antenna.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point (HSP) is the center of the radar dome. The vertical survey point (VSP) is the ground at the base of the tower.

PHOTO



NAVIGATIONAL AID DESCRIPTION

Air Surveillance Radar (ASR)

Air Surveillance Radar is designed to provide relatively short-range coverage in the airport vicinity and to serve as an expeditious means of handling terminal area traffic. The ASR detects and displays an aircraft's position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 nautical miles.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is located at the center of rotation axis. The vertical survey point is located at ground level on a centerline of the horizontal survey point.

PHOTO

NAVIGATIONAL AID

Distance Measuring Equipment (DME)

Distance measuring equipment – DME measures the distance directly from the aircraft to the ground station. This measurement is referred to as slant range distance. The difference between a measured distance on the surface and the DME slant range is greatest when an aircraft is directly over the station, at which time it actually measures altitude. DME is often co-located with other navigational systems.

DESCRIPTION OF POINT OBSERVED

The horizontal and vertical survey point is located at center of antenna cover NOTE: Elevation is only needed when frequency paired with ILS or Microwave landing system.

PHOTO

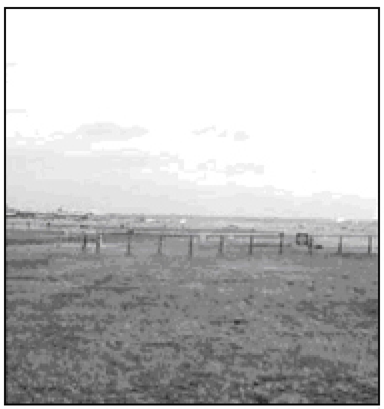
NAVIGATIONAL AID

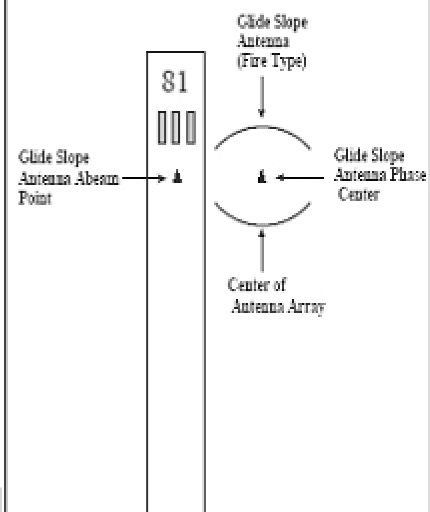
INSTRUMENT LANDING SYSTEM (FIRE TYPE)

DESCRIPTION OF POINT OBSERVED

The horizontal and vertical survey point on the glide slope is the top center of antenna array for obstruction purposes. Note: the antenna phase center is computed by taking the mean between each antenna array and computed at ground level. Note: abeam points must be computed in conjunction with all glide slope antennas. Abeam points are located on the centerline of the runway, perpendicular to the glide slope antenna.

PHOTO





NAVIGATIONAL AID

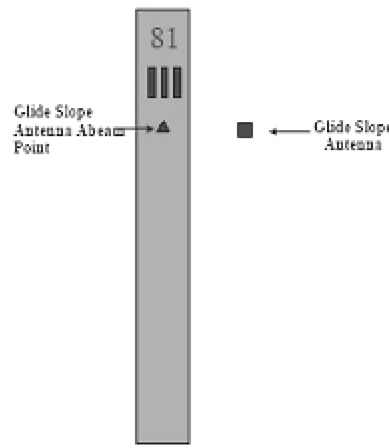
Glide Slope Antenna (Non Fire Type)

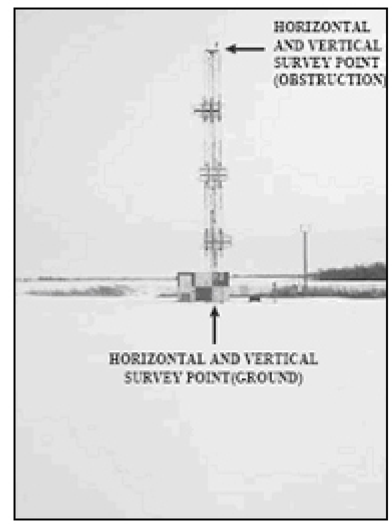
The Glide Slope informs the pilot with the airplane's vertical position relative to the ideal approach. The Glide Slope antenna is located off one side of the runway, approximately abeam the touchdown point (typically 1000 feet past the approach end of the runway). The standard glide-slope path is 3 degrees slope.

DESCRIPTION OF POINT OBSERVED

The horizontal and vertical survey point observed on the glide slope is the top center of supporting structure (for obstruction purposes), and an additional vertical survey point is at ground level center of supporting structure. NOTE: abeam points must be computed in conjunction with all glide slope antennas. Abeam points are located on the centerline of the runway, perpendicular to the glide slope antenna.

PHOTO





NAVIGATIONAL AID

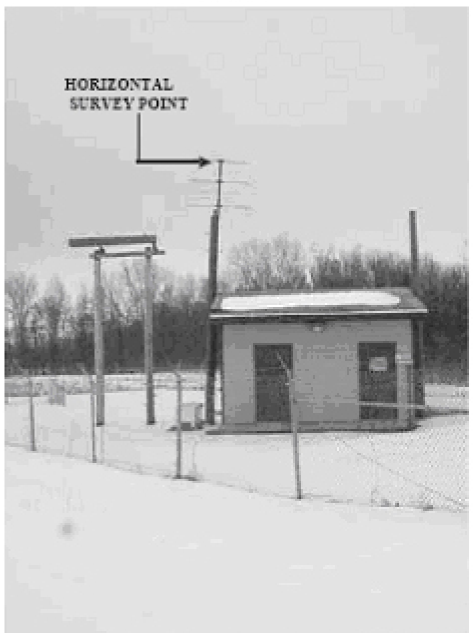
Inner Marker

Inner Marker is used only for Category II operations. Marker Beacons are to alert the pilot that an action is needed. This information is presented to the pilot by audio and visual cues.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point for the inner marker is the center of the antenna array. There is no vertical survey point requirement.

PHOTO



NAVIGATIONAL AID DESCRIPTION

LOCALIZER (LOC)

The Localizer informs the pilot with the airplane's horizontal position relative to runway centerline. The Localizer broadcasts from beyond the departure end of the runway with a horizontal antenna array. Course width is adjusted to provide full-scale deflection left or right at 350 feet off centerline when over the approach end of the runway. Course width varies with runway length.

DESCRIPTION OF POINT OBSERVED

The Horizontal and Vertical Survey Point is located at the center of antenna supporting structure.

PHOTO

NAVIGATIONAL AID DESCRIPTION

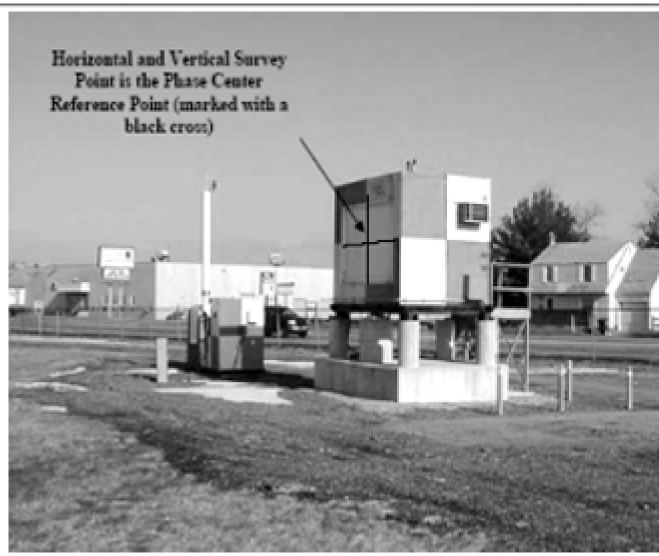
MLSAZ

The MLS is a precision approach and landing guidance system which provides position information and various ground-to-air data. The position information is provided in a wide coverage sector and is determined by an azimuth angle measurement (MLSAZ)

DESCRIPTION OF POINT OBSERVED

The Horizontal and Vertical Survey Point is located at the phase center reference point.

PHOTO



NAVIGATIONAL AID DESCRIPTION

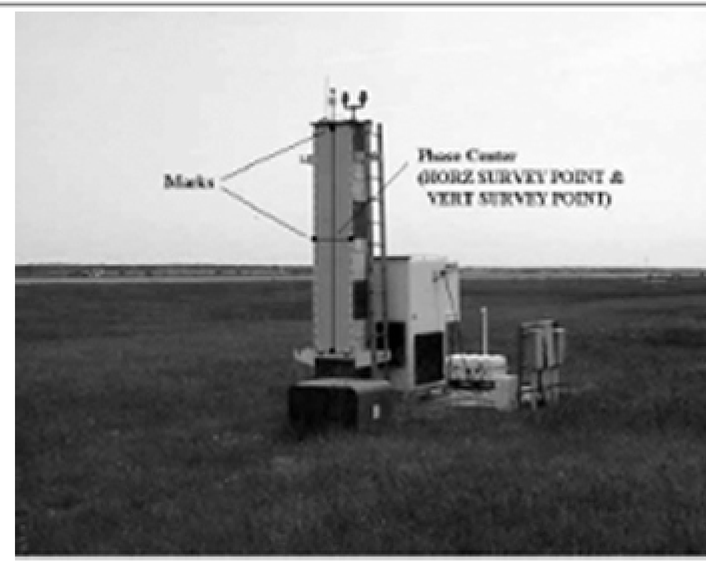
MLS ELEVATION GUIDANCE (MLSEL)

The elevation station transmits signals on the same frequency as the azimuth station. A single frequency is time-shared between angle and data functions. The elevation transmitter is normally located about 400 feet from the side of the runway between runway threshold and the touchdown zone.

DESCRIPTION OF POINT OBSERVED

The Horizontal and Vertical Survey Point is located at the Phase Center Reference Point.

PHOTO



NAVIGATIONAL AID DESCRIPTION

NONDIRECTIONAL BEACON (NDB)

Non-Directional Beacon (NDB) is another ground-based navigational aid used throughout the United States. The NDB system is the oldest form of electronic navigation still in regular use. By transmitting low to medium frequencies to an automatic direction finder located in the aircraft, pilots can use the NDB system to navigate to and from the ground-based station. NDB's may be co-located with an ILS system. NDB's may also provide a non-precision approach

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is located at the Center of Antenna Array. No vertical required.

PHOTO

NAVIGATIONAL AID DESCRIPTION

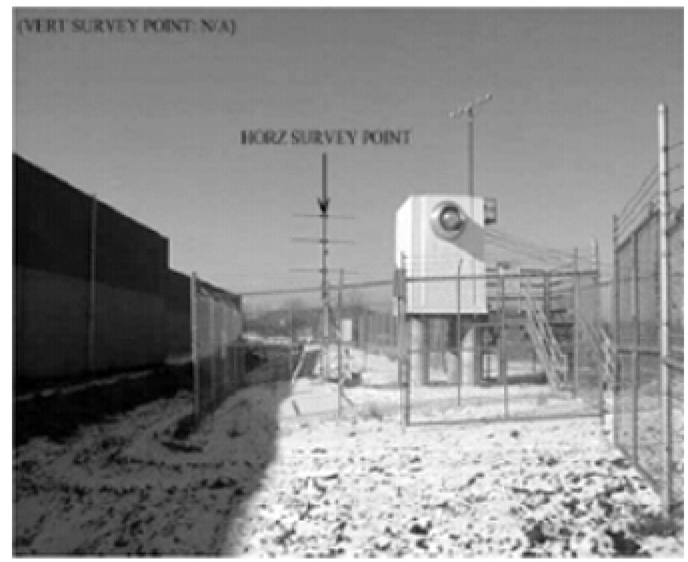
MIDDLE MARKER (MM)

Middle Marker (MM) beacon is located 2,000 to 6,000 feet (600 to 1 800 m) from the runway threshold. The middle marker defines a point along the glideslope of an ILS normally located at or near the point the point of decision height.

DESCRIPTION OF POINT OBSERVED

The Horizontal Survey Point is located at the Center of Antenna Array. No vertical required.

PHOTO



NAVIGATIONAL AID

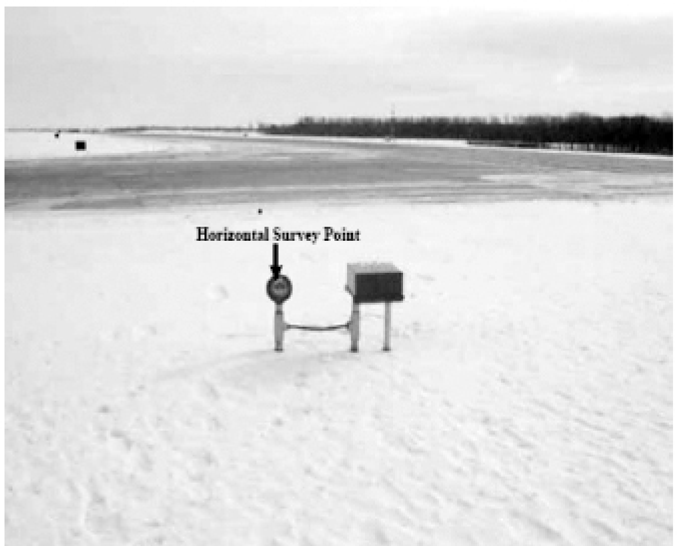
Runway End Identifier Lights (REIL)

Runway End Identifier Lights (REIL) consists of high intensity white strobe lights placed on each side of the runway to enable rapid and positive identification of the runway threshold. REILs are typically installed on runways where an approach lighting system is not available.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point (HSP) observed is the top center of light. No vertical required.

PHOTO



NAVIGATIONAL AID

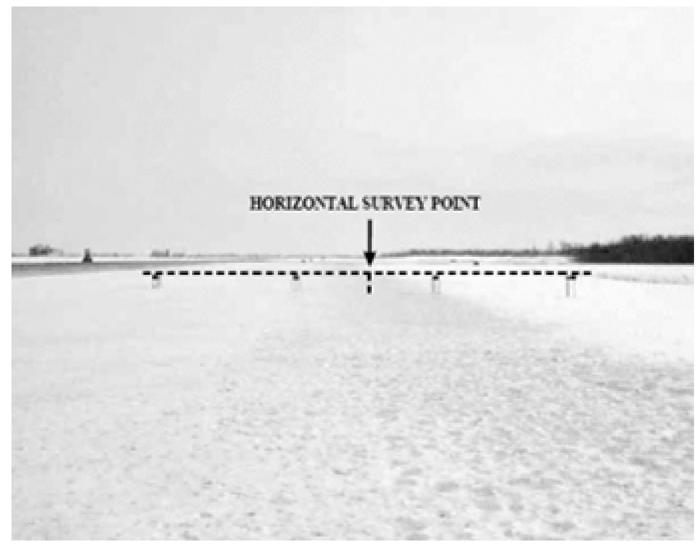
Precision Approach Path Indicators (PAPI)

Precision Approach Path Indicators is a visual-approach slope aid approved for use in the United States. This system gives indication that is more precise to the pilot of the approach path of the aircraft and utilizes only one bar. The system consists of four lights on either side of the approach runway. The PAPI are white and red lights arranged in a single row. If you are on the proper glide path, you will see two white lights on the left side of the PAPI light bar and two red lights on the right side.

DESCRIPTION OF POINT OBSERVED

The Horizontal Survey Point on PAPI lights is the center of array. No vertical is required.

PHOTO



NAVIGATIONAL AID

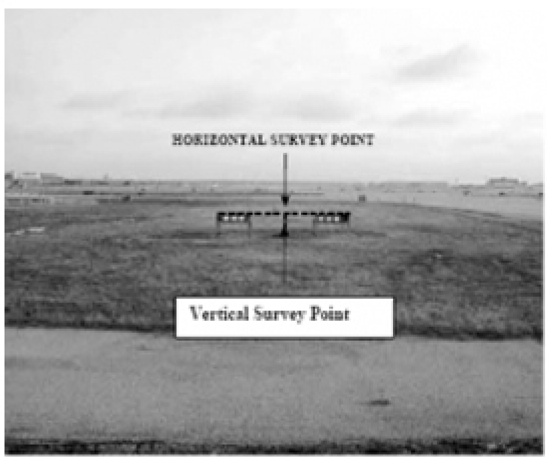
VASI

VISUAL APPROACH SLOPE INDICATOR (VASI) is an optical reference device located on the ground adjacent to the sides of the runway. There is a variety of VASI designs dependent upon the desired visual range and the type of aircraft utilizing the runway. The lenses split the light into red and white beams. If you are approaching the runway on the proper glide path, you see a red light above a white light.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is the center of array. The Vertical Survey Point is located at ground level on a centerline of the horizontal survey point.

PHOTO



NAVIGATIONAL AID

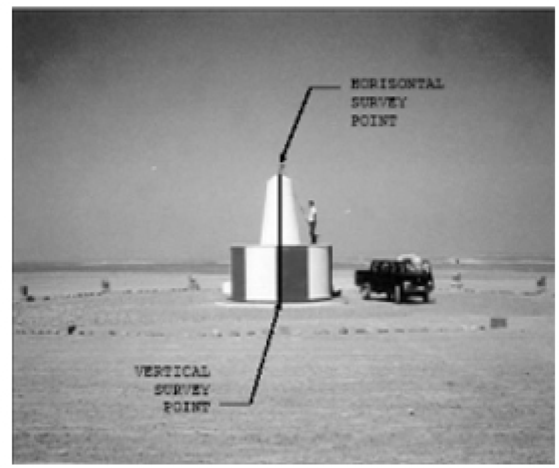
Very High Frequency Omni-directional Range Station (VOR)

VHF Omni-directional Range (VOR) – The VOR is a ground based short distance navigation aid (NAVAID) which provides continuous azimuth information in the form of 360 radials to or from a station. It is used for en route navigation as well as non-precision approaches. The VOR system is present in three slightly different navigation aids (NAVAIDs): VOR, VOR/DME, and VORTAC. By itself, it is known as a VOR, and it provides magnetic bearing information to and from the station. When DME is also installed with a VOR, the NAVAID is referred to as a VOR/DME. When military tactical air navigation (TACAN) equipment is installed with a VOR, the NAVAID is known as a VORTAC. DME is always an integral part of a VORTAC. Regardless of the type of NAVAID utilized (VOR, VOR/DME or VORTAC), the VOR indicator behaves the same.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is located on the top center of antenna cover. The vertical survey point is located at ground level center of structure.

PHOTO



NAVIGATIONAL AID

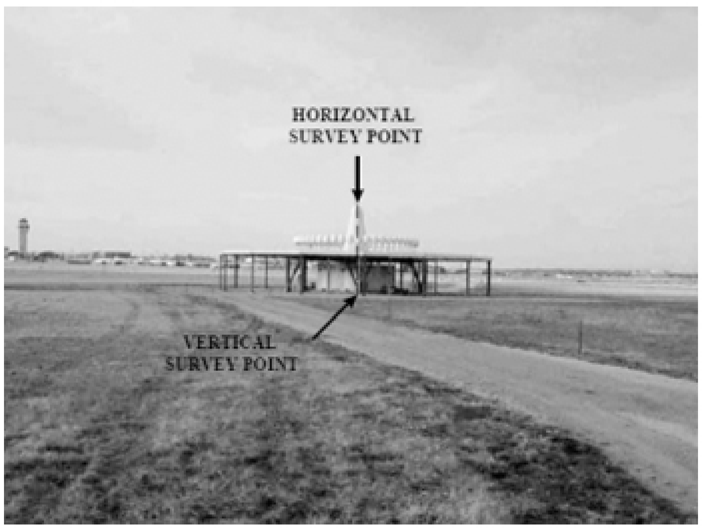
Very High Frequency Omni-directional Range Station(VOR)

VHF Omni-directional Range (VOR) – The VOR is a ground based short distance navigation aid (NAVAID) which provides continuous azimuth information in the form of 360 radials to or from a station. It is used for en route navigation as well as non-precision approaches. The VOR system is present in three slightly different navigation aids (NAVAIDs): VOR, VOR/DME, and VORTAC. By itself, it is known as a VOR, and it provides magnetic bearing information to and from the station. When DME is also installed with a VOR, the NAVAID is referred to as a VOR/DME. When military tactical air navigation (TACAN) equipment is installed with a VOR, the NAVAID is known as a VORTAC. DME is always an integral part of a VORTAC. Regardless of the type of NAVAID utilized (VOR, VOR/DME or VORTAC), the VOR indicator behaves the same.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is located on the top center of antenna cover. The vertical survey point is located at ground level center of structure.

PHOTO



NAVIGATIONAL AID / WEATHER AID DESCRIPTION

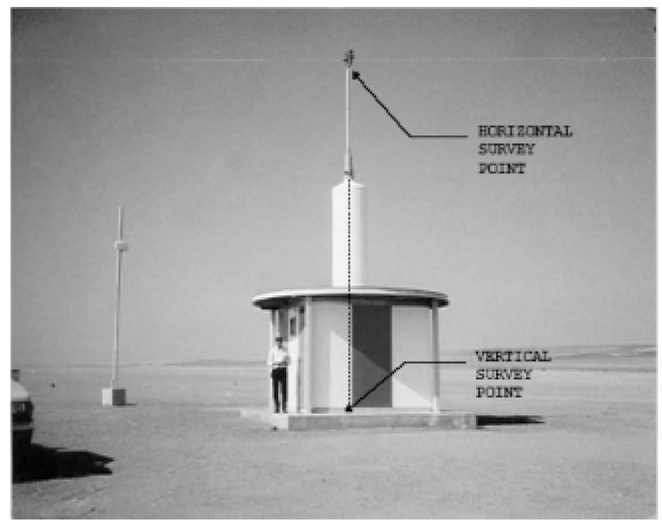
Very High Frequency Omni-directional Range Station (VOR WITH DME)

VOR/DME: If the VOR station is equipped with distance measuring equipment (DME), the signals can also be used to determine the distance to the station. It also provides navigation guidance for en route navigation and non-precision approaches.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is located on the top center of antenna cover. The vertical survey point is located at ground level center of structure.

PHOTO



NAVIGATIONAL AID

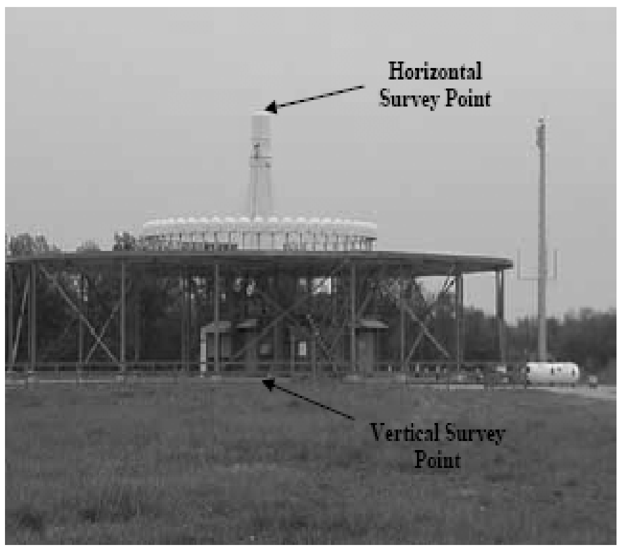
VORTAC

The VORTAC is simply a VOR and TACAN co-located and providing the same navigational assistance.

DESCRIPTION OF POINT OBSERVED

The horizontal survey point is located on the top center of antenna cover. The vertical survey point is located at ground level center of structure.

PHOTO



CHAPTER 16. OBSTRUCTIONS

The airspace around an airport is comprised of several imaginary three-dimensional obstruction identification surfaces (OIS), as defined in 14 CFR Part 77. These surfaces provide the criteria for determination of obstructions to navigable airspace. The supplemental instructions provided by the contracting official in the SOW will specify the approach category (condition) to which each runway end approach must be surveyed. The specified approach category (Visual, Utility, Non-Precision, Precision) for each runway end, the position and elevation of each runway end, and the airport elevation will determine the limits of the associated Primary, Horizontal, Conical, and Transitional surfaces to be surveyed. The surveyor must provide the required obstruction representation to these surfaces. The Aeronautical Data Collection and Analysis Tool (ADCAT) available from FAA provides the capability to model the required surfaces to assist the survey team in meeting these requirements.

One reason an object is considered an obstruction to air navigation is if it penetrates one of the required surfaces. The elevation required for any obstacle to obstruct an imaginary surface depends on the location of the obstacle within the airspace of the airport. The ADCAT software will allow the surveyor to identify, verify, position, and evaluate field-determined objects relative to the various imaginary surfaces. Survey teams must develop the ability to quickly judge the location of an object in the field relative to the various imaginary surfaces. The survey team must understand the definitions and interrelations between the various imaginary surfaces.

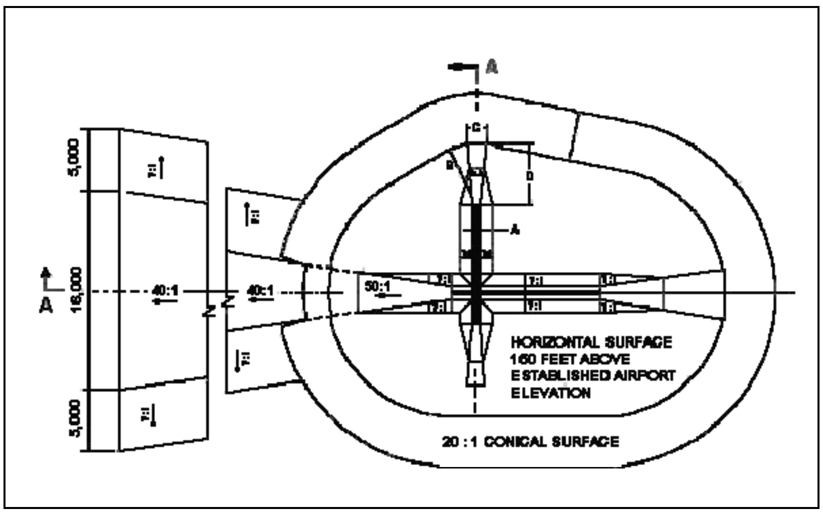


Fig 3-9: Illustrates the different 14 CFR Part 77 surfaces

16-1. DEFINITION

An obstruction, for purposes of this section, is any non-frangible obstacle penetrating an OIS, as defined in 14 CFR Part 77. A supplemental obstruction is any non-frangible obstacle penetrating an OIS defined as a supplemental OIS by appropriate FAA authorities.

16-2. OBSTRUCTION IDENTIFICATION SURFACES (OIS)

16-2-1. Precision Instrument Runway Surfaces – Category PIR

16-2-1-1. PIR Primary Surface: The primary surface is a 1,000-foot-wide rectangle centered on the runway centerline, beginning 200 feet on the approach side of a runway threshold and extending to 200 feet on the approach side of the opposite runway threshold. The transitional surfaces associated with the primary surface, extend outward and upward perpendicular to the runway centerline at a slope of 7 to 1 (14.29 percent approximately) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

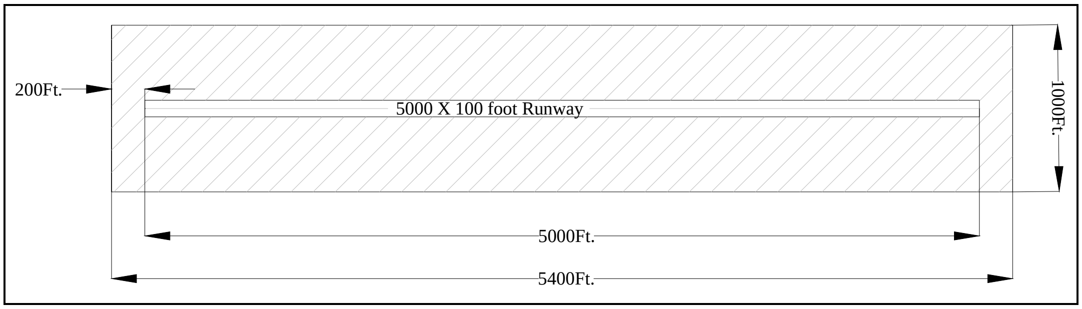


Figure 3-10: The hatched area around the runway, depicts the dimensions of the primary surface for a precision instrument runway

Table 3-6: Primary surface dimensional criteria – PIR

Surface begins:	200 feet on approach side of each runway threshold
Length:	Distance between runway thresholds plus 400 feet
Width of the surface at point of beginning:	1,000 feet (500 feet either side of centerline)
Width of surface at end point:	1,000 feet (500 feet either side of centerline)
Slope of surface:	See elevation.
Elevation:	The surface follows the contours of the runway centerline. At each threshold, the surface is at the same elevation as the threshold and continues at that elevation to the 200-foot point.

16-2-1-2. PIR Approach Surface: A PIR approach surface is longitudinally centered on the extended centerline of a PIR runway, beginning at the end of the primary surface and extending outward and upward at a slope of 50 to 1 (2.0 percent) for a horizontal distance of 10,000 feet and at a slope of 40 to 1 (2.5 percent) for an additional 40,000 feet. This surface width is 1,000 feet wide at the point of beginning and increases uniformly to a width of 16,000 feet at a distance of 50,000 feet from the end of the primary surface.

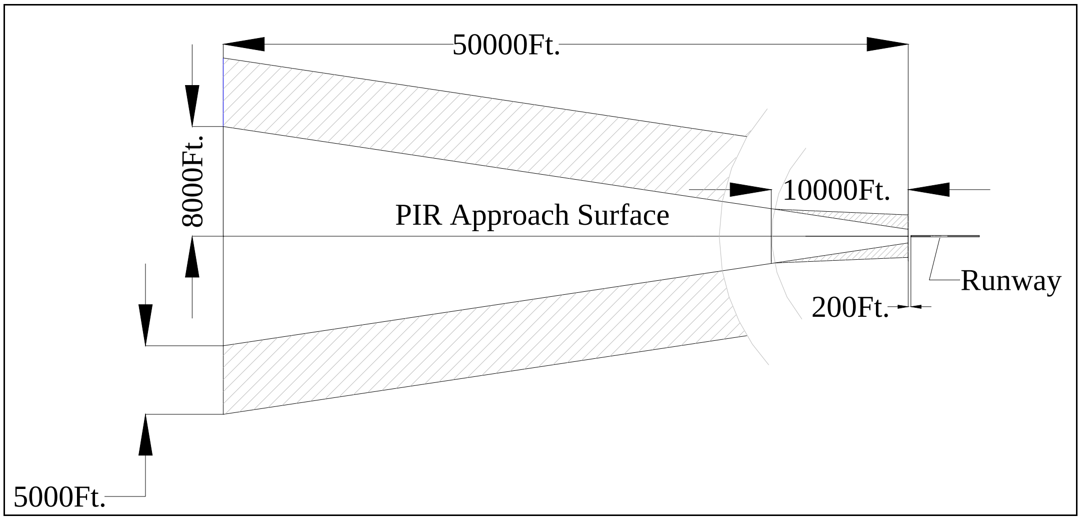


Figure 3-11: Depicts the plan view dimensional criteria of the PIR approach surface

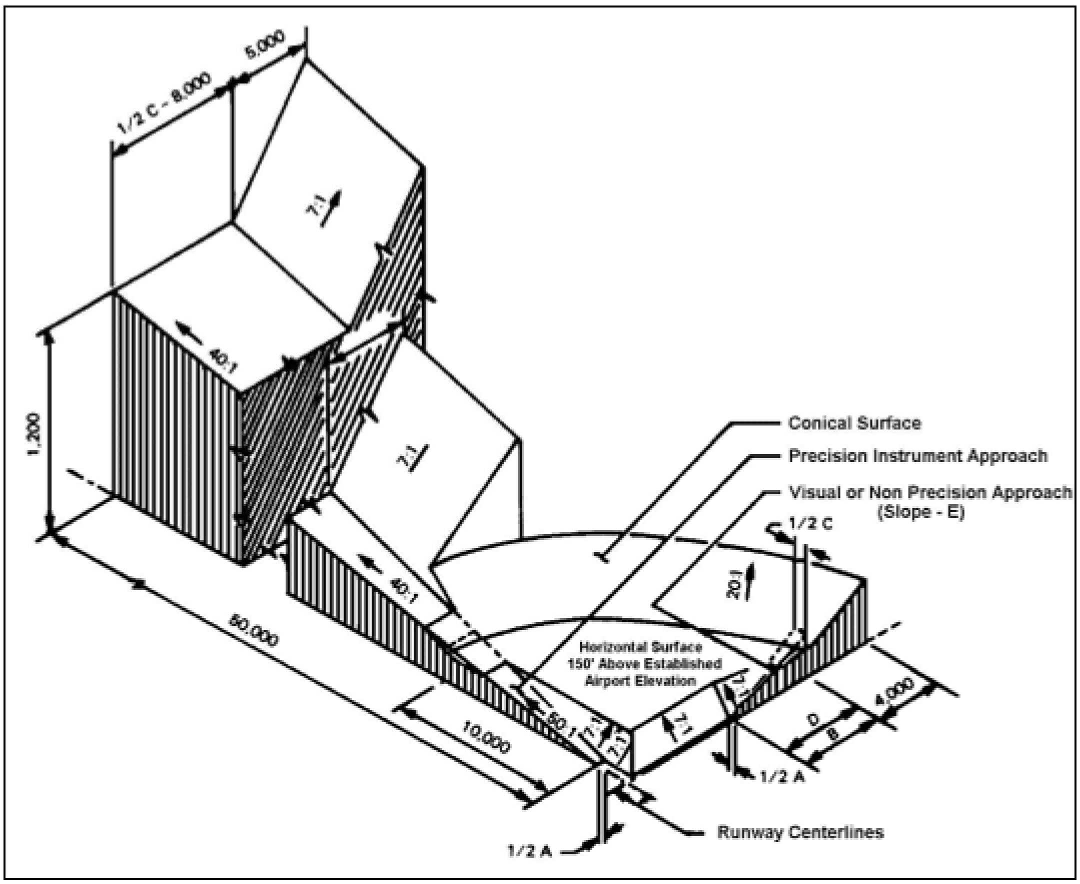


Figure 3-12: Provides an isometric view of the 14 CFR Part 77 surfaces

Table 3-7: Primary approach surface dimensional criteria – PIR

Surface begins:	200 feet on approach side of threshold (at end of primary surface)
Length:	50,000 feet
Width of the surface at point of beginning:	1,000 feet (500 feet either side of centerline)
Width of surface at end point 50,000 feet:	16,000 feet (8000 feet either side of centerline)
Slope of surface:	50:1 (2%) for first 10,000 feet 40:1 (2.5%) for last 40,000 feet
Elevation:	Beginning Elevation: Threshold Elevation Elevation at 10,000 feet: 200 feet above threshold Elevation Elevation at 50,000 feet: 1,200 feet above Threshold Elevation

16-1-1-3. PIR Transitional Surfaces: These surfaces extend outward and upward perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the approach surfaces until they intersect the horizontal or conical surface. The portion of the PIR approach surface extending beyond the limits of the conical surface extends a distance of 5,000 feet measured horizontally from the edge of the approach surface. The slope is 7 to 1 (14.3 percent).

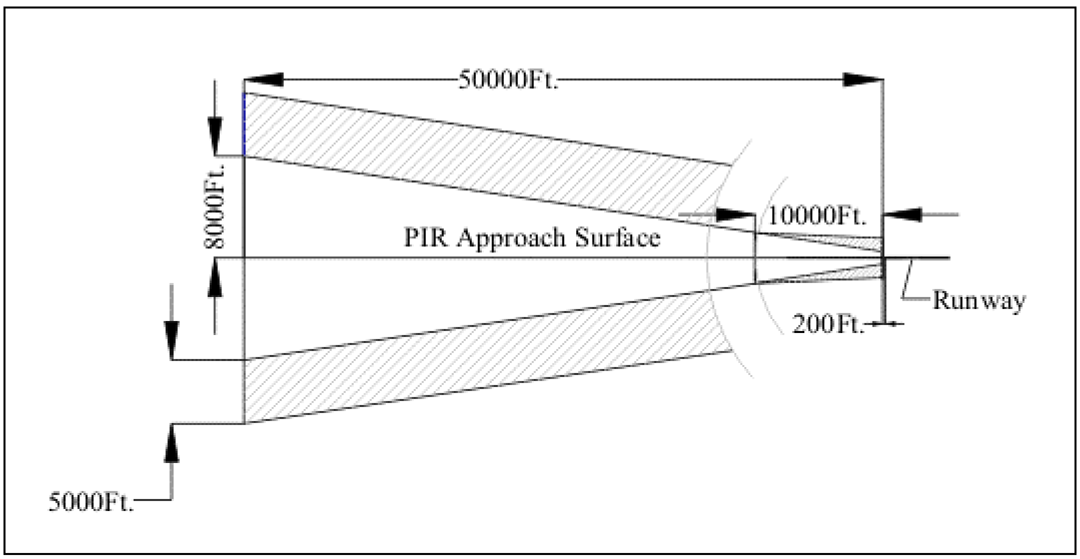


Figure 3-13: Depicts the plan view dimensional criteria of the PIR transitional surfaces (hatched areas)

Table 3-8: Transitional surface dimensional criteria – PIR

Surface begins:	200 feet. on approach side of threshold (at end of primary surface)
Length:	Computed using formula ((Airport Elev. – Runway End Elev.) + 150) ÷ 0.0200
Width of the surface at point of beginning:	Computed using formula ((Airport Elev. – Runway End Elev.) + 150) ÷ 0.1428571
Width of surface at end point 50,000 feet:	A PIR Approach Surface that project beyond the limits of the Conical Surface extends a distance of 5,000 feet measured horizontally from the edge of the Approach Surface. The slope is 7-1 (14.3 percent).
Slope of surface:	7:1 (14.28571%) perpendicular to runway centerline/centerline extended

16-2-2. Non-Precision Runway Surfaces – Category D (NP-D)

16-2-2-1. Non-Precision – D Primary Surface: The primary surface is a 1,000-foot-wide rectangle centered on the runway centerline, beginning 200 feet on the approach side of a runway threshold and extending to 200 feet on the approach side of the opposite runway threshold. The transitional surfaces associated with the primary surface extend outward and upward perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

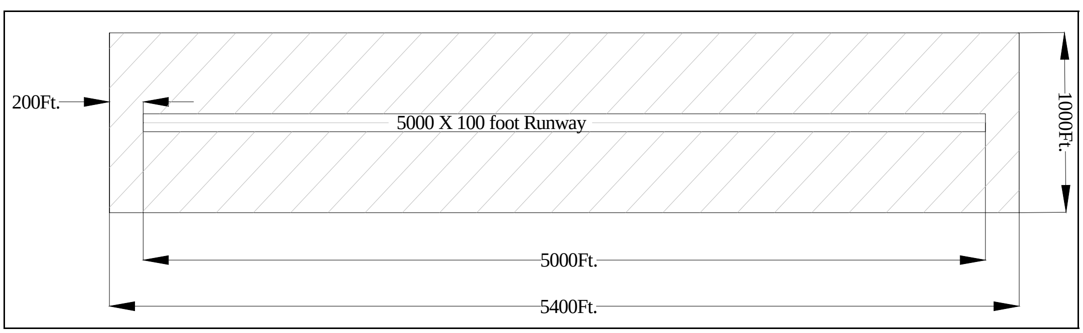


Figure 3-14: The hatched area surrounding the runway is the NP-D primary approach surface

Table 3-9: Primary surface dimensional criteria – NP-D

Surface begins:	200 feet on approach side of each runway threshold
Length:	Distance between runway thresholds plus 400 feet
Width of the surface at point of beginning:	1,000 feet (500 feet either side of centerline)
Width of surface at end point:	1,000 feet (500 feet either side of centerline)
Slope of surface:	See elevation.
Elevation:	The surface follows the contours of the runway centerline. At each threshold, the surface is at the same elevation as the threshold and continues at that elevation to the 200-foot point.

16-2-2-2. NP-D Approach Surface: This surface is longitudinally centered on the extended centerline of the runway, beginning at the end of the primary surface and with dimensions based on the permissible approach visibility minimums established for the specific runway end. The visibility minimum for the D is as low as ¾ mile. The primary surface width at end adjacent to runway end and flaring to 4,000 feet at a distance of 10,000 feet from the end of the primary surface. The surface slope is 34 to 1 (approximately 3 percent).

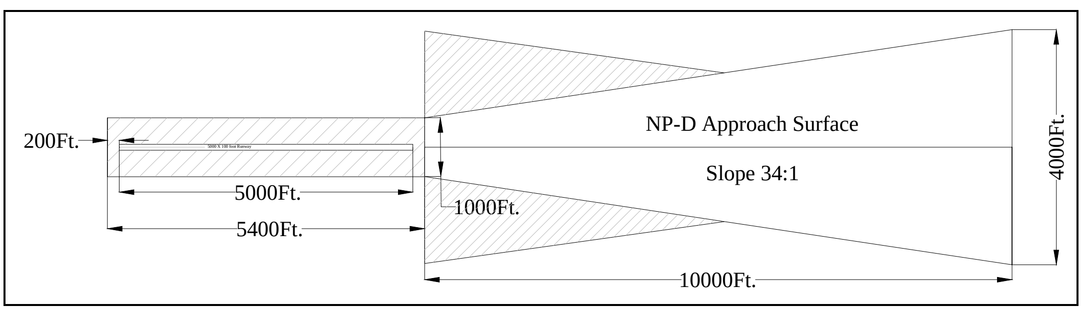


Figure 3-15: Depicts the plan view dimensional criteria of the NP-D primary approach surface

Table 3-10: Primary surface dimensional criteria – NP-D

Surface begins:	200 feet on approach side of each runway threshold
Length:	10,000 feet
Width of the surface at point of beginning:	1,000 feet (500 feet either side of centerline)
Width of surface at end point:	4,000 feet (2000 feet either side of centerline)
Slope of surface:	34:1 (2.94117%)
Elevation:	Beginning: Elevation of Threshold End Point: 294.1 feet above threshold elevation

16-2-2-3. NP-D Transitional Surfaces: These surfaces extend outward and upward perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

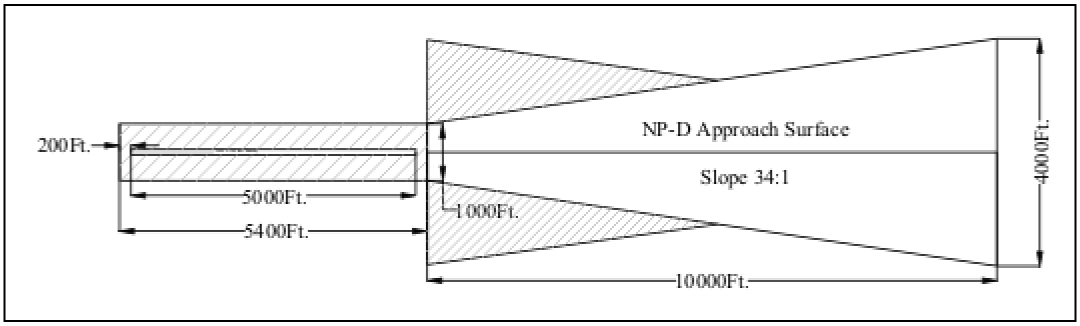


Figure 3-16: Depicts the NP-D approach surface and the transitional surfaces (hatched areas)

Table 3-11: Transitional surface dimensional criteria – NP-D

Surface begins:	200 feet on approach side of each runway threshold
Length:	Computed Using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.0294117
Width of the surface at point of beginning:	Computed using formula ((Airport Elev. – Runway End Elev.) + 150) ÷ 0.1428571
Width of surface at end point:	The transitional surface extends until it reaches the horizontal or conical surface.
Slope of surface:	7:1 (14.28571%)

16-2-3. Non-Precision Runway Surfaces – Category C (NP-C)

16-2-3-1. NP-C Primary Surface: The primary surface is a 500-foot-wide rectangle centered on the runway centerline, beginning 200 feet on the approach side of a runway threshold and extending to 200 feet on the approach side of the opposite runway threshold. The transitional surfaces associated with the primary surface extend outward and upward, perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

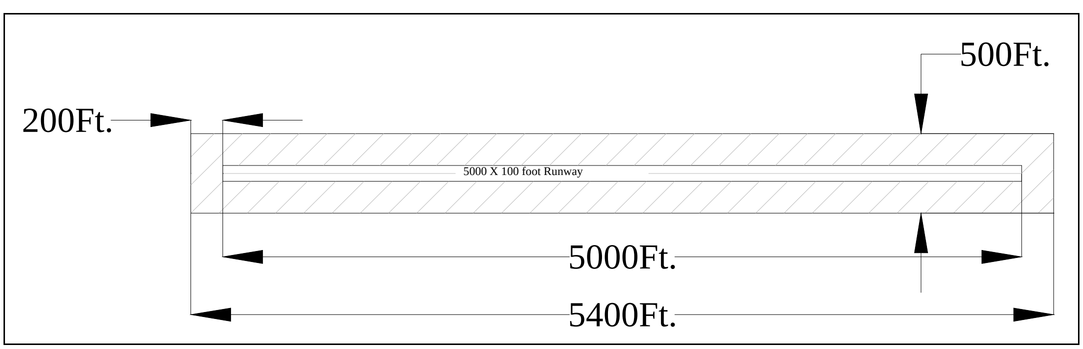


Figure 3-17: Depicts the NP-C primary surface (hatched areas)

Table 3-11: Primary surface dimensional criteria – NP-C

Surface begins:	200 feet on approach side of each runway threshold
Length:	Distance between runway thresholds plus 400 feet
Width of the surface at point of beginning:	500 feet (250 feet either side of centerline)
Width of surface at end point:	500 feet (250 feet either side of centerline)
Slope of surface:	See elevation.
Elevation:	The surface follows the contours of the runway centerline; at each threshold, the surface is at the same elevation as the threshold and continues at that elevation to the 200-foot point.

16-2-3-2. NP-C Approach Surface: A surface longitudinally centered on the extended centerline of the runway, beginning at the end of the primary surface and with dimensions based on the permissible approach visibility minimums established for the specific runway end. The visibility minimum for the NP-C is greater than ¾ mile. The NP-C approach surface is the width of the primary surface at the point of beginning and flares to 3,500 feet at a distance of 10,000 feet from the end of the point of beginning. The surface slope is 34 to 1 (3 percent).

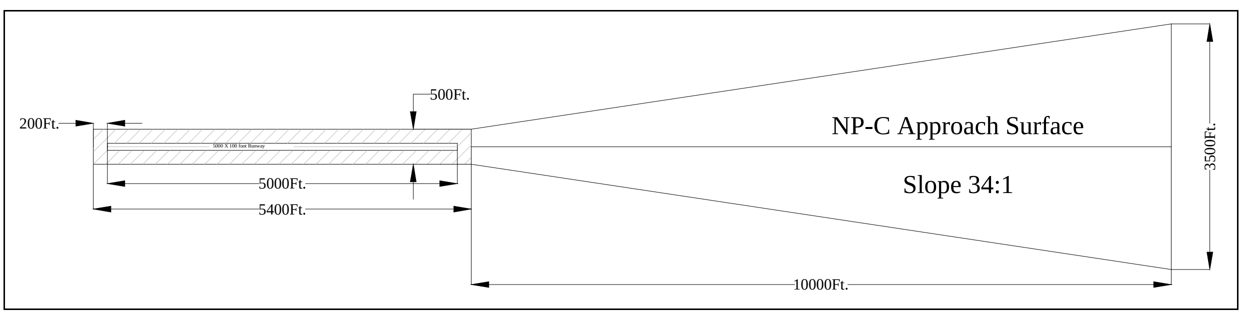


Figure 3-18: Depicts the NP-C approach surface (hatched areas)

Table 3-12: Approach surface dimensional criteria – NP-C

Surface begins:	200 feet on approach side of each runway threshold
Length:	10,000 feet
Width of the surface at point of beginning:	500 feet (250 feet either side of centerline)
Width of surface at end point:	3500 feet (1,750 feet either side of centerline)
Slope of surface:	34:1 (2.94117%)
Elevation:	Beginning: Elevation of threshold End Point: 294.1 feet above threshold elevation

16-2-3-3. NP-C Transitional Surfaces: Transitional surfaces extend outward and upward, perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

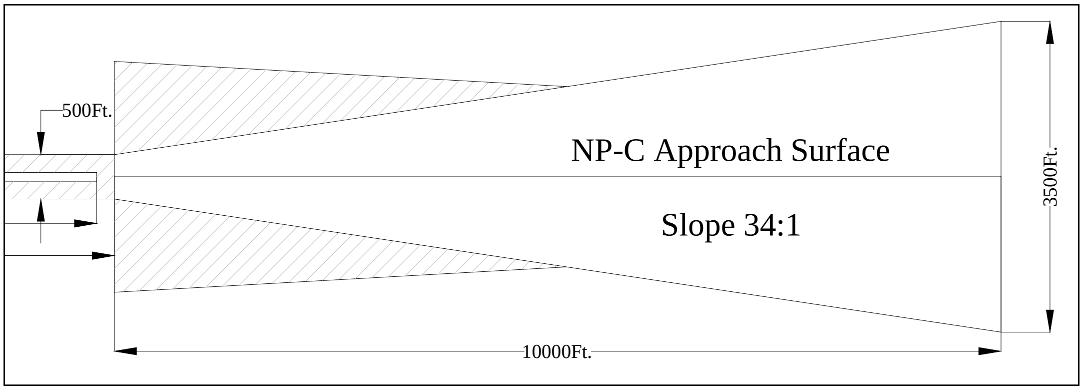


Figure 3-19: Depicts the NP-C approach and approach transitional surfaces (hatched areas)

Table 3-13: Approach transitional surface dimensional criteria – NP-C

Surface begins:	200 feet on approach side of each runway threshold
Length:	Computed using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.0294117
Width of the surface at point of beginning:	Computed using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.1428517
Slope of surface:	34:1 (2.94117%)

16-2-4. Non-Precision Runway Surfaces – Category ANP

16-2-4-1. ANP Primary Surface: The primary surface is a 500-foot-wide rectangle centered on the runway centerline, beginning 200 feet on the approach side of a runway threshold and extending to 200 feet on the approach side of the opposite runway threshold. The transitional surfaces associated with the primary surface, extend outward and upward perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

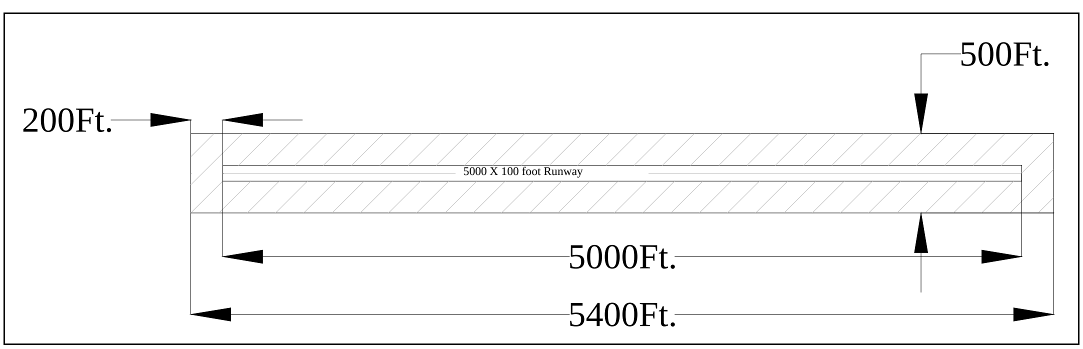


Figure 3-20: Depicts the NP-C primary surface (hatched areas)

Table 3-14: Primary surface dimensional criteria – ANP

Surface begins:	200 feet on approach side of each runway threshold
Length:	Distance between runway thresholds plus 400 feet
Width of the surface at point of beginning:	500 feet (250 feet either side of centerline)
Width of surface at end point:	500 feet (250 feet either side of centerline)
Slope of surface:	See elevation
Elevation:	The surface follows the contours of the runway centerline; at each threshold, the surface is at the same elevation as the threshold and continues at that elevation to the 200-foot point.

16-2-4-2. ANP Approach Surface: Utility runways with non-precision approach surfaces are not affected by visibility minimums. The width of these surfaces is 500 feet at the end of the primary surface and flares to a width of 2,000 feet at a distance of 5,000 feet from the end of the primary surface. The surface slope is 20 to 1 (5 percent).

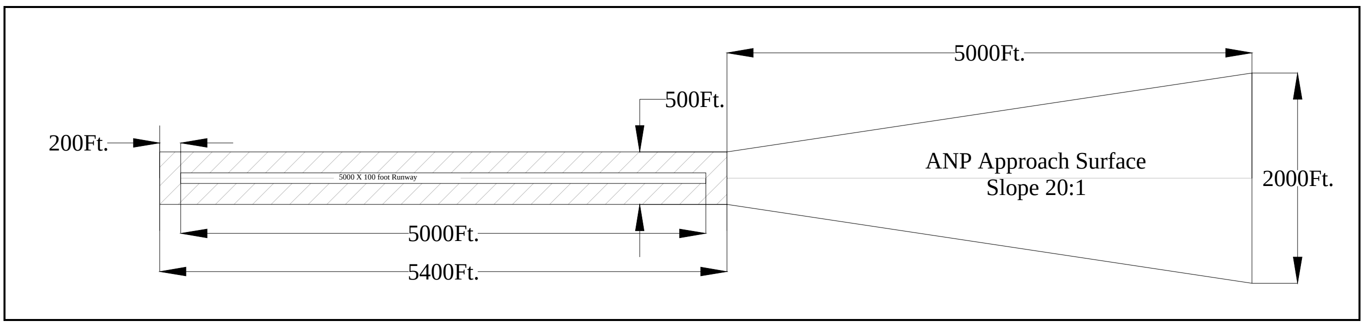


Figure 3-21: Depicts the ANP approach surface dimensions

Table 3-15: Approach surface dimensional criteria – ANP

Surface begins:	200 feet on approach side of each runway threshold
Length:	5,000 feet
Width of the surface at point of beginning:	500 feet (250 feet either side of centerline)
Width of surface at end point:	2,000 feet (1000 feet either side of centerline)
Slope of surface:	20:1 (5.000%)
Elevation:	Beginning: Elevation of threshold End Point: 250 feet above threshold elevation

16-2-4-3. ANP Approach Transitional Surfaces: Transitional surfaces extend outward and upward, perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

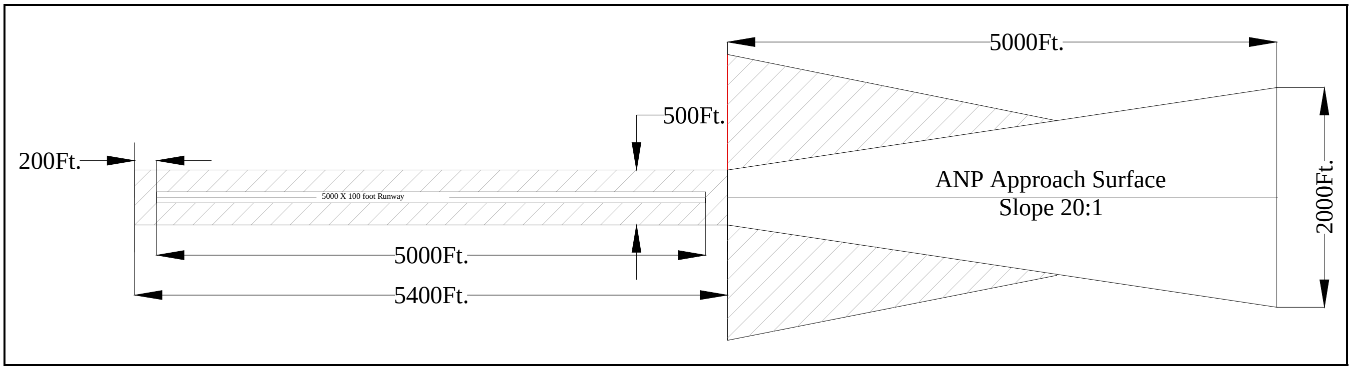


Figure 3-22: Depicts the ANP Transitional Surface Dimensions

Table 3-16: Approach transitional surface dimensional criteria – ANP

Surface begins:	200 feet on approach side of each runway threshold
Length:	Computed Using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.0500
Width of the surface at point of beginning:	Computed Using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.1428517
Slope of surface:	20:1 (5.00%)

16-2-5. Visual Runway Surfaces – Category BV

16-2-5-1. BV Primary Surface: The primary surface is a 500-foot-wide rectangle centered on the runway centerline, beginning 200 feet on the approach side of a runway threshold and extending to 200 feet on the approach side of the opposite runway threshold. The transitional surfaces associated with the primary surface extend outward and upward perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

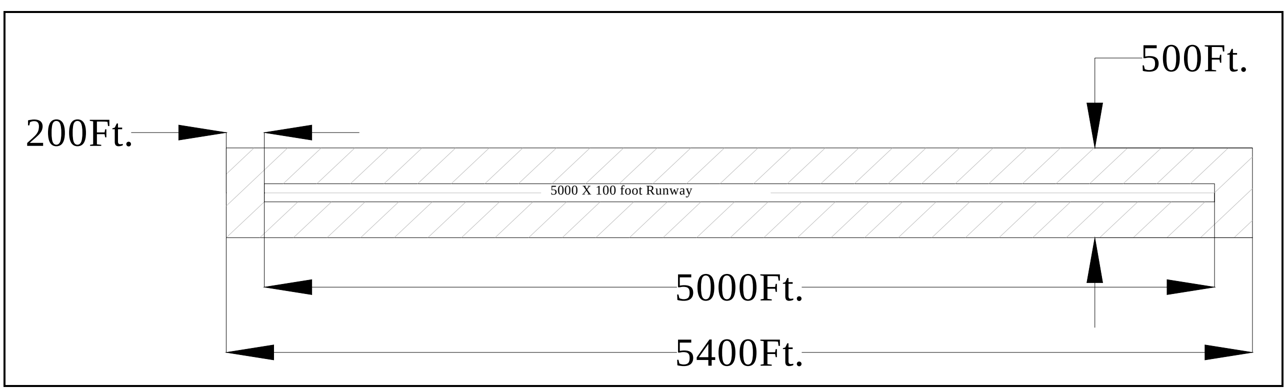


Figure 3-23: Depicts the BV primary surface (hatched areas)

Table 3-17: Primary surface dimensional criteria – BV

Surface begins:	200 feet on approach side of each runway threshold
Length:	Distance between runway thresholds plus 400 feet
Width of the surface at point of beginning:	500 feet (250 feet either side of centerline)
Width of surface at end point:	500 feet (250 feet either side of centerline)
Slope of surface:	See elevation.
Elevation:	The surface follows the contours of the runway centerline; at each threshold, the surface is at the same elevation as the threshold and continues at that elevation to the 200 foot point.

16-2-5-2. BV Approach Surface: When the runway is not a utility runway, the visual runway approach surface is centered longitudinally on the extended centerline of the runway, beginning at the end of the primary surface. The width at this point is 500 feet, and it flares to 1,500 feet at a distance of 5,000 feet from the end of the primary surface. The surface slope is 20 to 1 (5 percent).

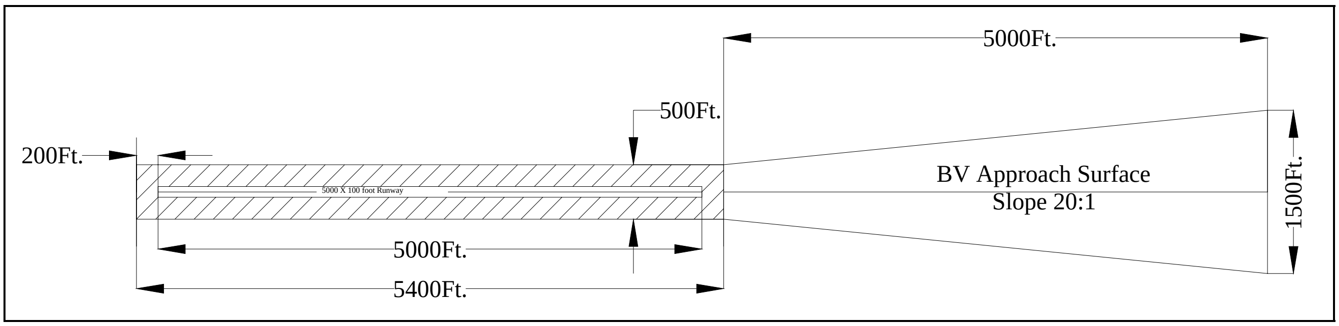


Figure 3-24: Depicts the BV approach surface

Table 3-18: Approach surface dimensional criteria – BV

Surface begins:	200 feet on approach side of each runway threshold
Length:	5,000 feet
Width of the surface at point of beginning:	500 feet (250 feet either side of centerline)
Width of surface at end point:	1,500 feet (750 feet either side of centerline)
Slope of surface:	20:1 (5.000%)
Elevation:	Beginning: Elevation of threshold End Point: 250 feet above threshold elevation

16-2-5-3. BV Approach Transitional Surface: Transitional surfaces extend outward and upward, perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

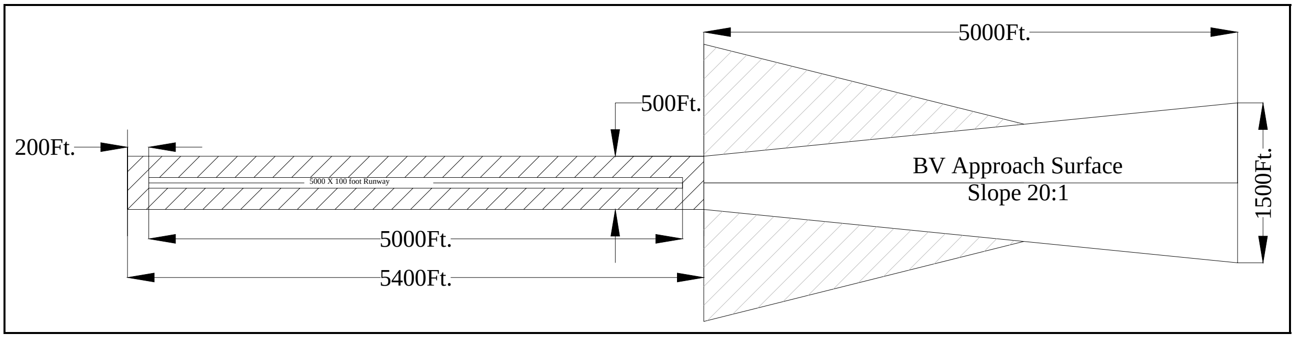


Figure 3-25: Depicts the BV approach transitional surface (hatched areas)

Table 3-19: Approach transitional surface dimensional criteria – BV

Surface begins:	200 feet on approach side of each runway threshold
Length:	Computed Using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.0500
Width of the surface at point of beginning:	Computed Using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.1428517
Slope of surface:	20:1 (5.00%)

16-2-6. Visual Runway Surfaces – Category AV

16-2-6-1. AV Primary Surface: The primary surface is a 250-foot-wide rectangle centered on the runway centerline, beginning 200 feet on the approach side of a runway threshold and extending to 200 feet on the approach side of the opposite runway threshold. The transitional surfaces associated with the primary surface extend outward and upward perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical surface.

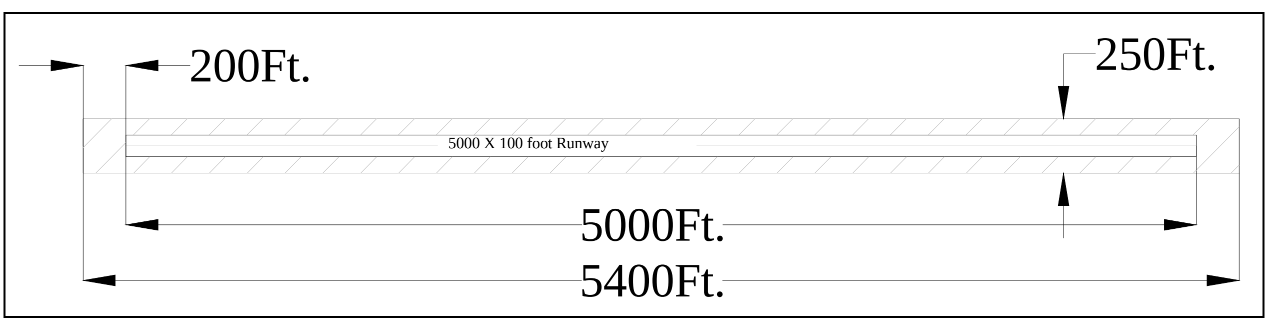


Figure 3-26: Depicts the AV primary surface (hatched areas)

Table 3-20: Primary surface dimensional criteria – AV

Surface begins:	200 feet on approach side of each runway threshold
Length:	Distance between runway thresholds plus 400 feet
Width of the surface at point of beginning:	250 feet (125 feet either side of centerline)
Width of surface at end point:	250 feet (125 feet either side of centerline)
Slope of surface:	See elevation.
Elevation:	The surface follows the contours of the runway centerline; at each threshold, the surface is at the same elevation as the threshold and continues at that elevation to the 200 foot point.

16-2-6-2. AV Approach Surface: When the runway is a utility runway, the width begins at 250 feet at the end of the primary surface and flares to a width of 1,250 feet at a distance of 5,000 feet from the end of primary surface. The surface slope is 20 to 1 (5 percent).

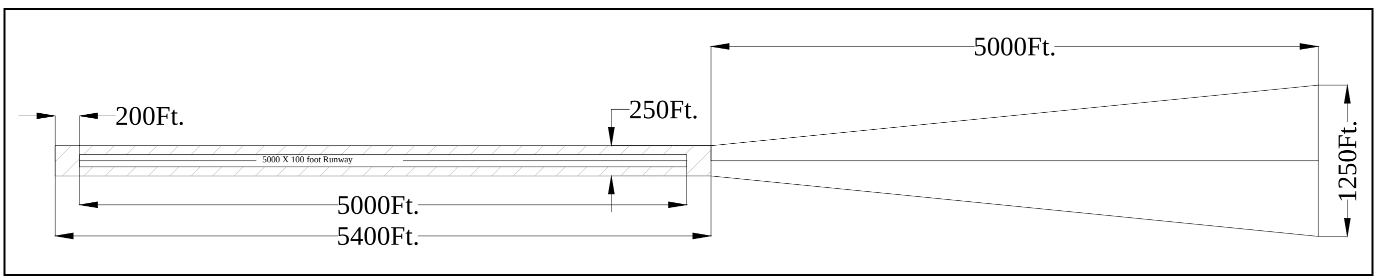


Figure 3-27: Depicts the AV approach surface

Table 3-21: Approach surface dimensional criteria – AV

Surface begins:	200 feet on approach side of each runway threshold
Length:	5,000 feet
Width of the surface at point of beginning:	250 feet (125 feet either side of centerline)
Width of surface at end point:	1,250 feet (625 feet either side of centerline)
Slope of surface:	20:1 (5.000%)
Elevation:	Beginning: Elevation of threshold End Point: 250 feet above threshold elevation

16-2-6-3. AV Approach Transitional Surfaces: These surfaces extend outward and upward, perpendicular to the runway centerline at a slope of 7 to 1 (approximately 14.29 percent) from the edge of the primary and the approach surfaces until they intersect the horizontal or conical suffice.

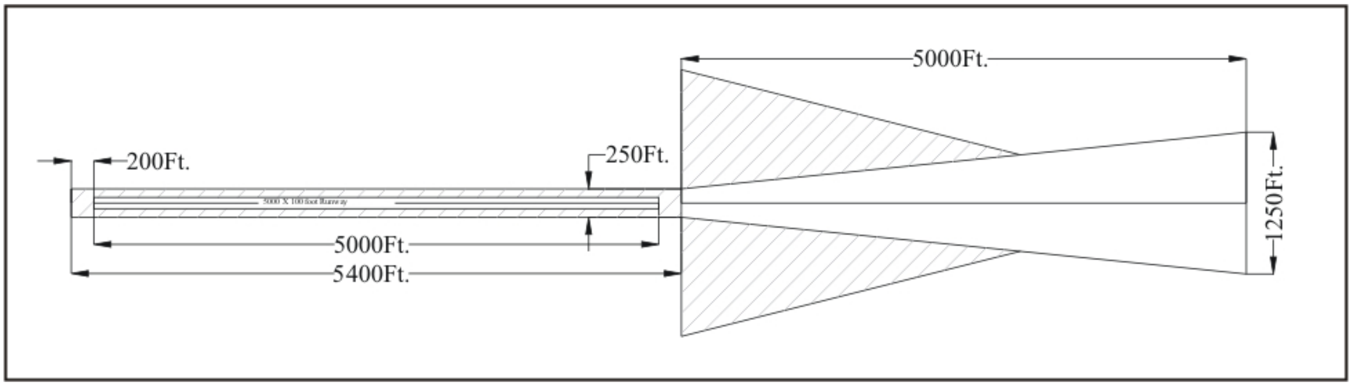


Figure 3-28: Depicts the AV approach transitional surface (hatched area)

Table 3-22: Approach transitional surface dimensional criteria – AV

Surface begins:	200 feet on approach side of each runway threshold
Length:	Computed Using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.0500
Width of the surface at point of beginning:	Computed Using formula ((Airport Elev. – Runway Elev.) + 150) ÷ 0.1428517
Slope of surface:	20:1 (5.00%)

16-2-7. HORIZONTAL SURFACE

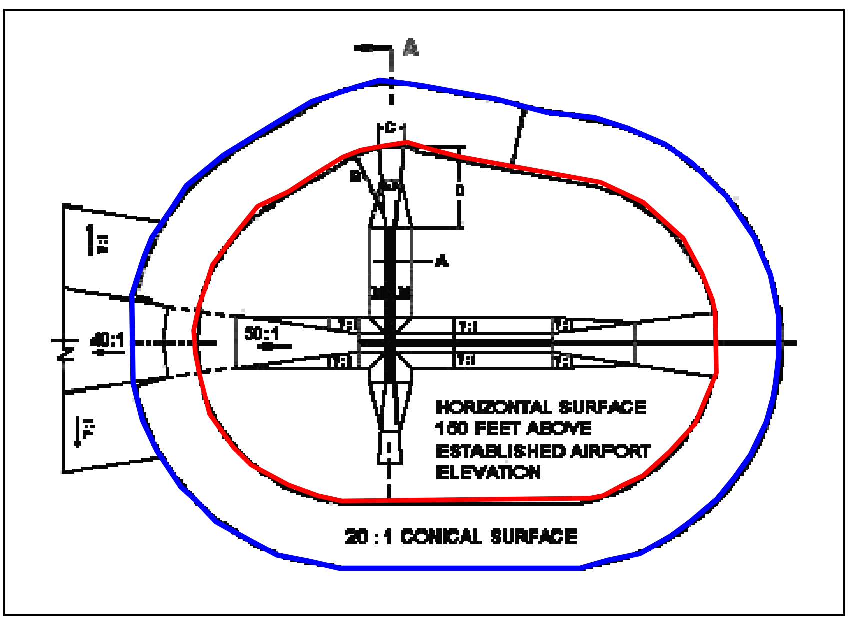


Fig. 3-30: Illustrates the outer limits of the Horizontal (red line) and Conical (blue line) Surfaces in a multi-runway configuration

A horizontal surface is a horizontal plane 150 feet above the established airport elevation, the perimeter of which is constructed by swinging arcs of specified radii from the center of each end of the primary surface of each runway. Tangents then connect the adjacent arcs. The sizes of the arcs are as follows:

- For all runways designated visual or utility, the radius of each arc is 5,000 feet.
- For precision and non-precision runways, the radius of each arc is 10,000 feet.

The radius of the arc specified for each end of a runway will have the same mathematical value, which is the highest determined value for either runway end. When tangents connecting two adjacent 10,000-foot arcs encompass a 5,000-foot arc, it must be disregarded.

16-2-8. CONICAL SURFACE

The conical surface extends upward and outward from the outer limits of the horizontal surface (for a horizontal distance of 4,000 feet). The slope of the conical surface is 20 to 1 (5 percent), measured in a vertical plane.

16-2-9. SUPPLEMENTAL SURFACES

These are surfaces applied to Airport Obstruction Charts when there is a requirement for additional obstruction data. Dimensions, slopes, etc. are the same as previously specified; however, they are used under conditions that do not meet the definitions. For example, a visual runway may be charted as both a visual runway and a non-precision runway. When such is the case, the non-precision surfaces will be designated “Supplemental Surface” on the chart. The requirement for supplemental surfaces is restricted to primary, approach, and transitional areas. The specified horizontal and conical surfaces charted are not affected by the addition of supplemental surfaces. The limits of the transitional surfaces for the supplemental data are based on the horizontal and conical surface limits associated with the supplemental approach surface.

16-3. OBSTACLE ACCURACIES

The accuracy standards for the obstructions/obstacles are presented in the table on the following page. When an obstacle is selected for its obstruction value only (for example, meteorological apparatus), obstruction accuracies apply.

Table 3-23: Obstacle accuracies

ITEM	(VALUES ARE FEET)	HORZ	VERTICAL ORTHO	VERTICAL ELLIP	VERTICAL AGL
Non-manmade obstacles and manmade obstacles less than 200 feet AGL that penetrate the following Obstruction Identification Surface:					
	A Primary Surface	20	3	3	N/A
	Those areas of an Approach Surface within 10,200 feet of the runway end	20	3	3	N/A
	Those areas of Primary Transition Surface within 500 feet of the Primary Surface	20	3	3	N/A
	Those areas of an Approach Transition Surface within 500 feet of the approach surface and also within 2,766 feet of the runway end	20	3	3	N/A
	Those areas of a Primary Transition Surface further than 500 feet from the Primary Surface	50	20	20	N/A
	Those areas of an Approach Transition Surface further than 500 feet from an Approach surface and also within 10,200 feet of the runway end	50	20	20	N/A
	The Horizontal Surface	50	20	20	N/A
	Those areas of an Approach Surface further than 10,200 feet from the runway end	100	50	50	N/A
	Those areas of an Approach Transition Surface further than 10,200 feet from the runway end	100	50	50	N/A
	The Conical Surface	100	50	50	N/A
Manmade objects equal to or greater than 200 feet AGL that penetrate the following Obstruction Identification Surfaces:					
	A Primary Surface	20	3	3	10
	Those areas of an Approach or Approach Transition Surface within 10,200 feet of the runway end	20	3	3	10
	The Primary Transition Surface	20	3	3	10
	An Approach or Approach Transition Surface further than 10,200 feet from the runway end	50	3	3	10
	The Horizontal Surface	50	3	3	10
	The Conical Surface	50	3	3	10

Notes:

- Accuracies are relative to the nearest PACS, SACS, HRP, or TSM.
- Distances relative to the threshold or runway end are measured along the runway centerline or centerline extended to the abeam point.

16-4. SPECIAL CASES

16-4-1. Catenaries

In most cases, the position and elevation of supporting towers will adequately represent catenaries. These towers must be treated as any other potential obstruction. However, if one or both towers are outside the limits of the OIS, the catenary itself may become a significant obstruction. In these cases, provide a position and elevation on the imaginary straight line connecting the tops of the two adjacent catenary support towers at the highest point within the OIS. Designate the elevation of this point as an estimated maximum elevation (EME).

16-4-2. Vehicular Traverse Ways

Treat a vehicular traverse way as any other potential obstruction, but include the appropriate vehicle height allowance in the elevation. Refer to Paragraph 16-4-8 for possible exemptions regarding vehicular traverse ways. Vehicle height allowances are as follows:

Non-interstate roads	**15 feet**
Interstate roads	**17 feet**
Railroads	**23 feet**

16-4-3. Mobile Obstructions

Representative obstructions that are mobile within a defined area (except vehicles on roads and railroads and vessels, which are treated under separate headings) must have their obstructing travel limits determined. Furnish an EME for each of these obstructing mobile obstacle areas. If a non-obstructing mobile obstacle is outward from the runway end, is the highest obstacle in the primary area or first 2,000 feet of an approach, and is higher than the runway end, an EME point must be provided at the point nearest to the runway centerline end. Travel limits need not be determined. Include the word **"MOBILE,"** which always implies an EME, in the obstacle name (e.g. "MOBILE CRANE AREA").

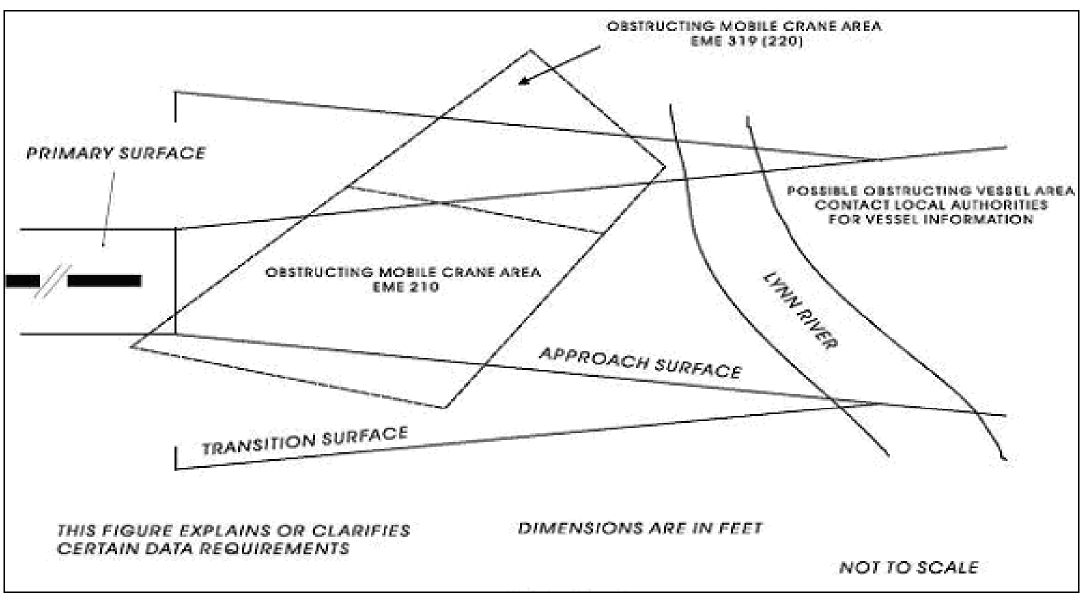


Figure 3-31: Illustrates the requirements for obstructing mobile areas

16-4-4. Obstructions Under Construction

Identify representative objects under construction (e.g. **“BUILDING UNDER CONSTRUCTION**”). Determine the elevation of the obstacle at the time of the survey. However, if a construction crane extends above the feature under construction, it is necessary and sufficient to determine the elevation and position of the crane.

16-4-5. Vessels

Because of uncertainties in determining maximum vessel heights, travel limits, and frequency of passage, vessel heights and locations are not provided. However, if a possible obstructing condition exists, an entry into the data logger (ADCAT) must be made cautioning of the possibility of vessels obstructing certain OISs at certain times and advising further investigation by the data user about maximum vessel height, travel limits, and frequency of passage.

16-4-6. Manmade Obstacles Equal to or Greater than 200 Feet Above Ground Level (AGL)

The AGL elevation must be determined for the required manmade obstacles equal to, or greater than, 200 feet AGL. Measure the height from the highest point of ground in contact with either the obstacle or the structure on which the obstacle rests.

16-4-7. Supplemental Obstructions

Accomplish an obstruction survey of a supplemental OIS when specifically requested by the appropriate airport sponsor or State aviation or FAA authorities. Accomplish the survey of supplemental obstructions in addition to the survey specified in 14 CFR Part 77 for existing conditions. Penetrations of the supplemental OIS are supplemental obstructions. The supplemental OIS must conform to one of the OIS standards defined in 14 CFR Part 77. Criteria for the selection of supplemental obstructions are the same as the criteria for the selection of other obstructions.

16-4-8. Obstruction Exemptions

The measurement and consideration of the following obstructions is not required:

(1). Vegetation that obstructs both by less than 3 feet and has a maximum cross-sectional diameter no greater than ½ inch where transected by an obstruction surface.

(2). Annual vegetation, such as annual weeds, corn, millet, and sugar cane.

(3). Frangible obstacles. Frangible obstacles are under the control of airport authorities with locations fixed by function. Frangible structures retain their structural integrity and stiffness up to a designated maximum load, but on impact from a greater load, they break, distort, or yield in such a manner as to present the minimum hazard to aircraft. Examples are runway and taxiway signs and many approach light structures.

(4). Roads with restricted public access intended for airport/facility maintenance only. This exemption does not apply to airport service roads associated with other airport operations, such as food, fuel, and freight transportation.

(5). Construction equipment and debris, including dirt piles and batch plants, that are—

(a). Temporary in nature.

(b). Under the control of airport authorities.

(c). Located on airport property

(6). Vessels. If a possible obstructing condition exists, make an entry into the data logger (ADCAT) cautioning that vessels might obstruct certain 14 CFR Part 77 surfaces (Approach or Primary versus Horizontal, Conical, or Transition OIS) at certain times and that further investigation, travel limits, and frequency of passage is advised. This exemption does not apply to vessels permanently moored.

(7). Individual parked aircraft. Show on the AOC paved aircraft movement and apron areas and approximate locations of unpaved tiedown areas. However, the location and maximum elevation of individual parked aircraft should not be determined or provided as part of an AOC survey. This exemption does not apply to aircraft permanently parked for display purposes.

16-4-8. Meteorological Apparatus

Measurement and consideration of meteorological apparatus is not required unless it is determined for its obstruction value.

16-5. OBSTACLE SELECTION

Obstruction selection must include a representation of obstacles penetrating the 14 CFR Part 77 OIS at the time of the field survey. The appropriate airport sponsor or State aviation or FAA authorities must identify the exact surfaces required for consideration for the survey. Additionally, certain non-obstructing obstacles may be required in the first 2,000 feet of an approach area. The special cases that apply to obstructions (refer to Paragraph 16-4) also apply to these required non-obstructing obstacles. Note that required obstacles may be EME points for mobile obstacle areas (refer to Figure 3-29).

16-5-1. OIS Obstacles Requirements

16-5-1-1. Determine and report the following obstructions in the primary surface.

(1). The highest obstruction outward from the runway end (the area located between the runway end and the beginning of the approach surface).

(2). The highest obstruction and the highest non-manmade obstruction in each 3,000-foot (approximately) section of the primary area on each side (left and right) of the runway.

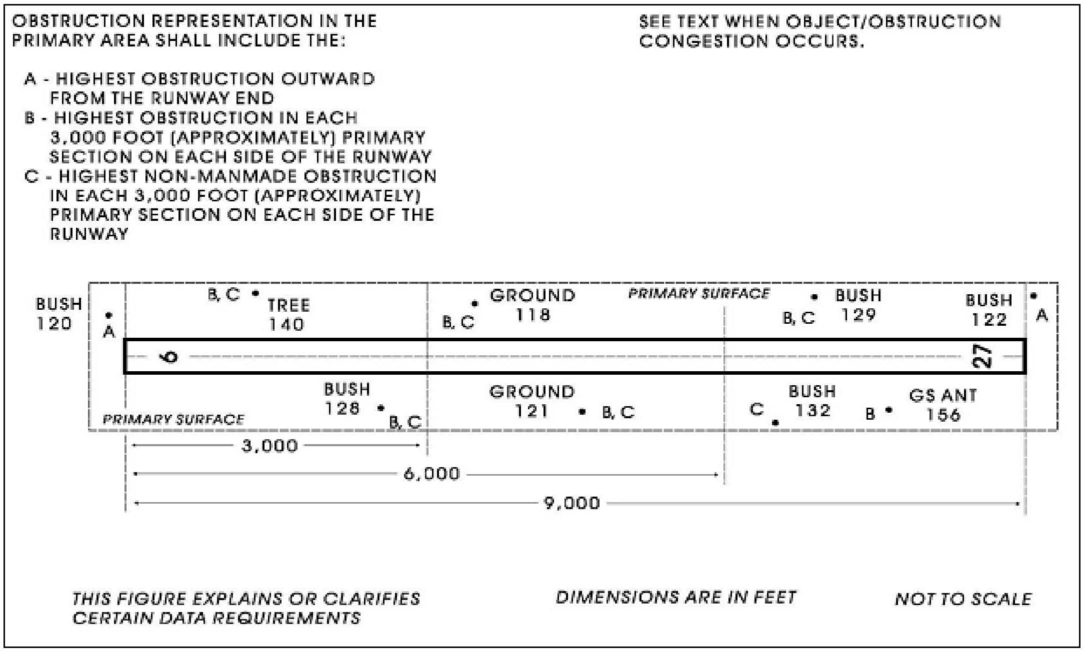


Figure 3-32: Illustrates the obstacle selection requirements in the primary surface

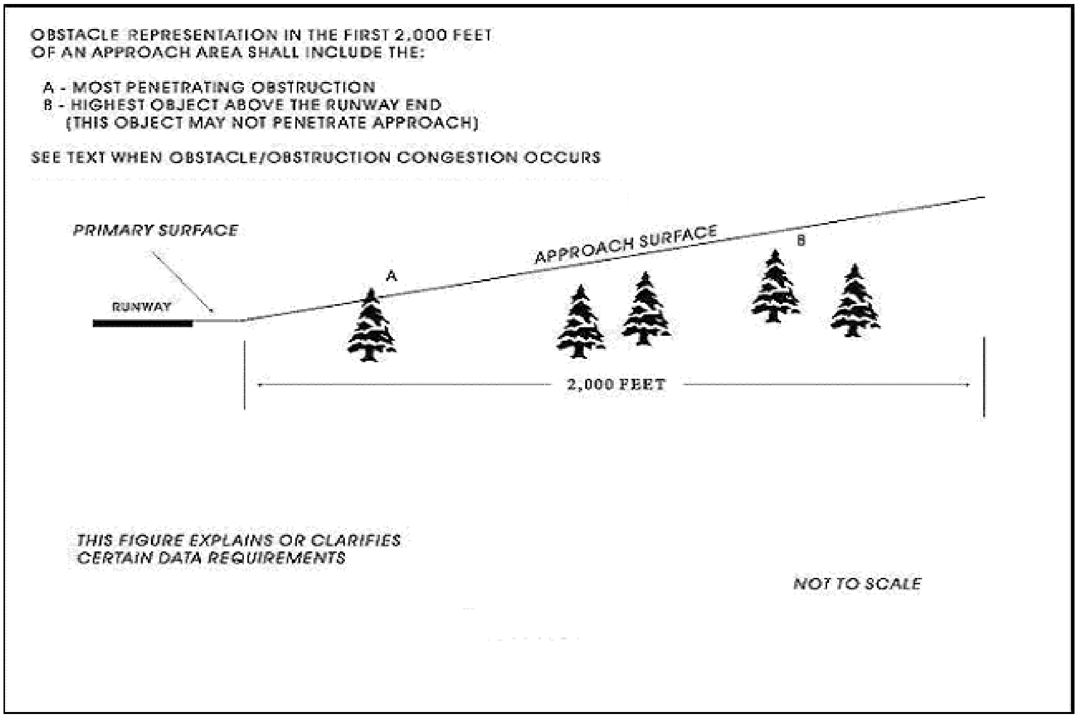
16-5-1-2. Determine and report the following obstructions in the approach surface.

(1). The highest obstacle within the first 2,000 feet of an approach area and higher than the runway approach end. This obstacle may or may not penetrate the approach surface and may be a non-obstructing EME point.

(2). The most penetrating obstruction in the first 2,000 feet of an approach area.

(3). The highest obstruction in each of the following zones of the approach:

- (a). First 10,000 feet,
- (b). First 20,000 feet,
- (c). First 30,000 feet,
- (d). First 40,000 feet, and
- (e). The approach area.



(f). Figure 3-33: Illustrates the requirements in the first 2,000 feet of the approach.

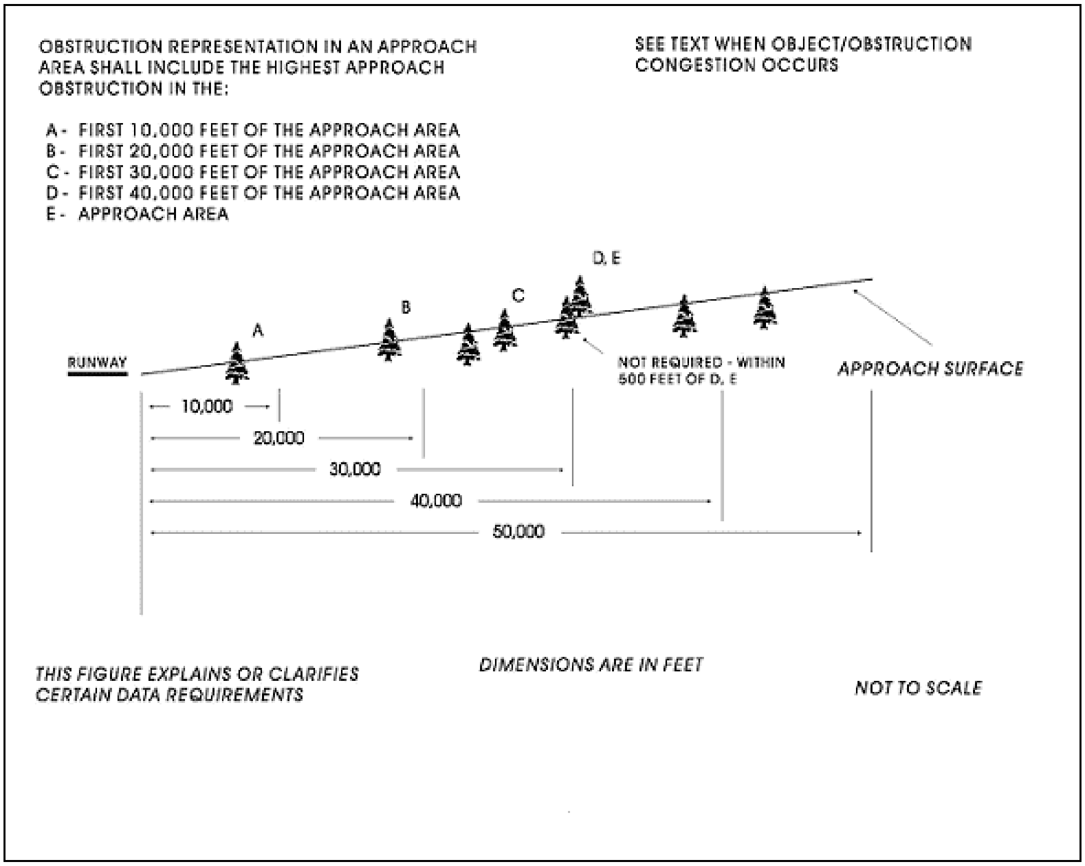


Figure 3-34: Illustrates the requirements in the approach

16-5-1-3. Determine and report the following obstructions in the Transition Surfaces:

(1). The highest obstruction in each 3,000-foot zone (approximately) of each primary transition to the horizontal surface. (The primary transition surface adjacent to the primary surface at each runway end must be extended an additional 200 feet (to cover an approximately 3,200- foot zone) to include the area adjacent to the 200-foot zone of the primary runway end. Refer to Figure 3-35.)

(2). The highest obstruction in each approach transition to the horizontal surface.

(3). The highest obstruction in each approach transition in the first 20,000 feet beyond the horizontal surface.

(4). The highest obstruction in each approach transition beyond the horizontal surface.

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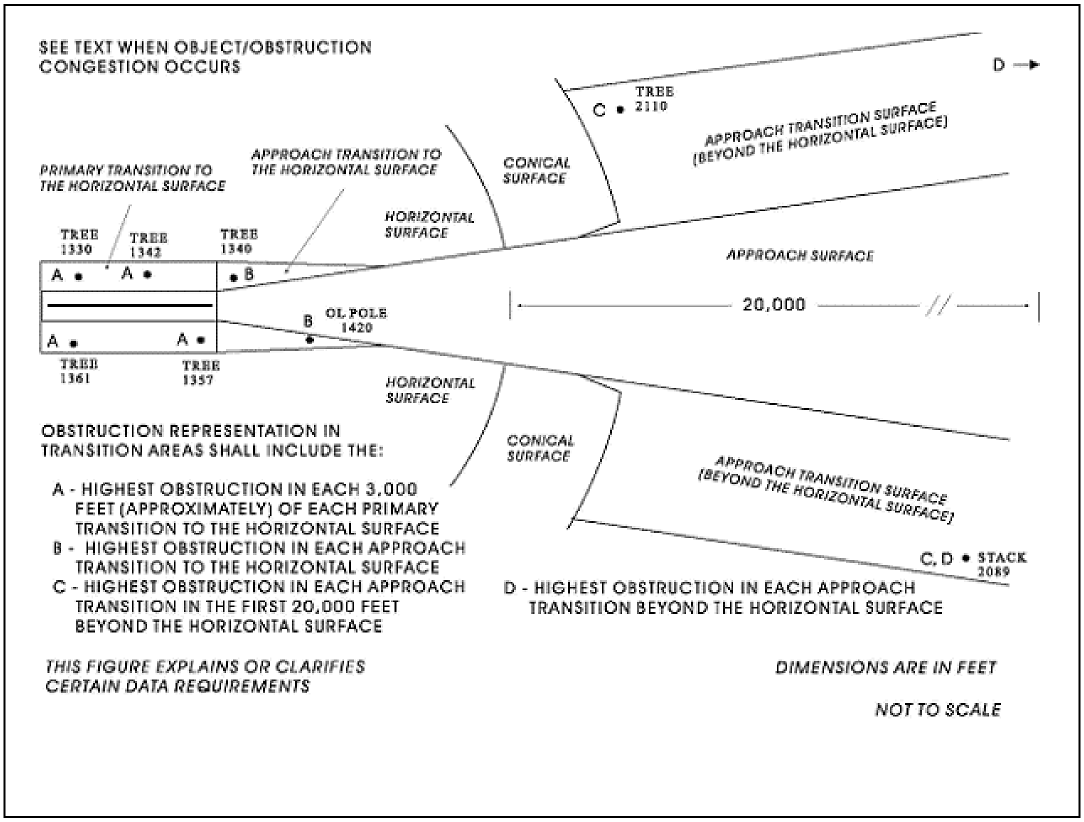

Figure 3-35: Illustrates the requirements in the transitional surfaces

16-5-1-4. Determine and report the following obstructions in the Horizontal and Conical Surfaces:

(1). The highest obstruction in either the horizontal or conical surface in each quadrant of the Part 77 survey area as defined by the meridian and parallel intersecting at the airport reference point (refer to Appendix 2, Section 2-1, to compute the airport reference point).

16-5-2. Area Limit Obstruction Requirements

An obstruction must be represented within the limits of each obstructing area to be compiled on the AOC. This representation must include the following:

(1). The highest obstruction within each obstructing area.

(2). The highest obstruction within that portion of an obstructing area that penetrates an approach surface.

(3). The highest obstruction within that portion of an obstructing area that penetrates a primary surface.

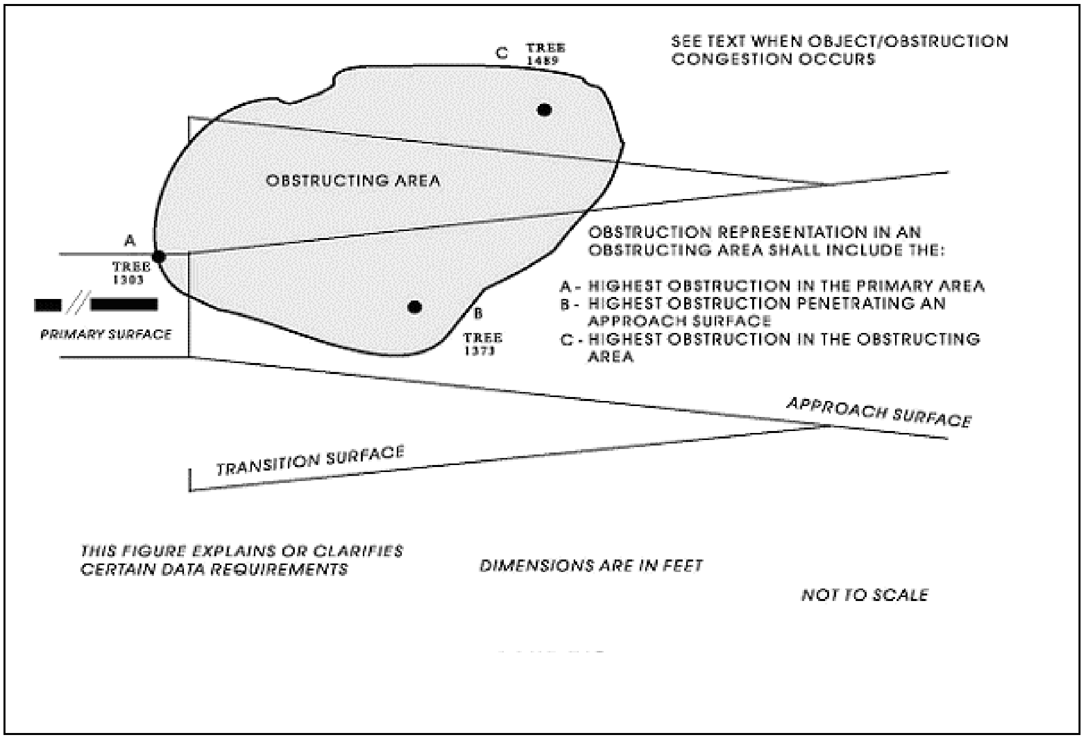

Figure 3-36: Illustrates the requirements for obstructing areas for approach, primary, and horizontal surfaces

16-5-3. Density Selection

In some cases, strict adherence to the obstacle selection criteria listed above might result in congestion or inadequate obstruction representation. To minimize these situations, the following guidelines must be followed in obstacle selection:

(1). If obstacles that are required in the primary area or first 10,000 feet of an approach area are located within 100 feet of each other, the lower obstacle may be omitted.

(2). If obstacles that are required outside the primary or first 10,000 of an approach area are located within 500 feet of each other, the lower obstacle may be omitted. (Note: Required primary or approach obstacles must not be omitted because of the close proximity of higher obstacles outside of the primary or approach areas).

(3). When a required obstacle is omitted because of congestion, a replacement obstacle/obstacles must be selected, if possible, that meets the spacing criteria.

(4). Occasionally, additional obstruction information may be useful in representing certain obstructing conditions. While a rigorous selection criterion is not practical, information useful to obstruction clearing activities should be considered in the selection.

16-6. AIRPORT OBSTRUCTION CHECKLIST

The selection criteria above are the minimum requirements that must be completed to satisfy the requirements in these General Specifications. The Airport Obstruction Checklist will be generated by the data logger (ADCAT) software. This checklist or an AOC checklist (refer to Appendix 2, Section 2-2, Recommended Data Collection Forms, provides guidance to ensure that the requirements for each of the zones will be completed.

CHAPTER 17. FINAL PROJECT REPORT

A Final Project Report must be delivered after the data has been collected and processed. Describe any changes from the submitted Survey and Quality Control Plan. The following describes the content and format of the report:

17-1. INTRODUCTION

(1). Airport Obstruction Chart (AL/AOC) number. Request this information from the FAA Airport Surveying–GIS Program Manager.
(2). Location Identifier (LID)
(3). Name of airport
(4). City
(5). State
(6). Contractor point of contact, including name, company name, address, telephone number, email
(7). Details of the Statement of Work
(8). Start and end dates of project

17-2. CONDITIONS AFFECTING PROGRESS

Discuss any equipment failures, weather, scope of project, site accessibility, reconnaissance, and/or any other problems affecting progress.

17-3. REMOTE SENSING WORK

(1). Chronology: Provide a brief description of the progression of the work.
(2). Remote Sensing Methodology: Provide a brief summary and details of any changes from information included in the Survey and Quality Control Plan.
(3). Imagery and Datums: Report on the type of imagery that was used and the method used to reference the horizontal and vertical control.
(4). Data Collection: Report on the methods and types of features collected by remote sensing. Include the accuracy of the imagery and the software used with version numbers.
(5). Obstacles: Report on the obstacles that were collected to satisfy the requirements listed in Part 3, Paragraph 16-5, Obstacle Selection. Refer to the obstruction checklist in Appendix 2, Section 2-2.
(6). Unusual Circumstances: Describe unusual circumstances; explain how and why special methods and/or procedures were followed.

17-4. FIELD WORK

(1). Chronology: Provide a brief description of the progression of the work.
(2). Interviews with Airport Officials: Provide a brief summary of all meetings with airport officials (refer to Part 1, Paragraph 8-5, Interviews).
(3). Reconnaissance: Provide a listing of NOAA survey marks recovered and those not recovered. Provide a listing of any new marks set. Include descriptions of any airport changes found, such as a new NAVAID (refer to Part 1, Paragraph 8-6, Reconnaissance).

(4). Instrumentation: Provide a listing of equipment used in the survey, including model and serial numbers, and maintenance reports.

(5). Survey Methodology: Provide a brief summary and details of any changes from information included in the Survey and Quality Control Plan. List horizontal and vertical datums used and published dates of NGS survey control.

(6). Survey Work: Provide general discussion and details of any problems:

- (a). List runways where obstructions were determined/evaluated.
- (b). Discuss PACS, SACS, and any other previous control used.
- (c). Discuss runway profiling and include, at minimum, the following:
  - (i). Profile method.
  - (ii). Any problems with runway length.
  - (iii). Discussions with manager.
  - (iv). Any changes.
  - (v). Whether authorities agreed (or disagreed) with runway dimensions surveyed.
- (d). Discuss NAVAIDs: Include, at least, statement that all NAVAIDs were surveyed and descriptions of any new NAVAIDs. State any changes to NAVAIDs. For example, list NAVAIDs that are new and commissioned, new and not commissioned (estimated date to be commissioned), decommissioned, or to be decommissioned (estimated date). State the source of information.
- (e). Discuss Obstructions: State whether this was a new or revision survey, whether all obstructions included in the Exchange File were verified or marked for deletion, whether additional obstructions were determined in all specified surfaces as necessary, and if there were any other changes. Make a definitive statement that all OISs were inspected and the required data was submitted.
- (f). Advisory Information: Identify photographs containing airport features. Discuss changes to the airport since the date of photography and the photograph showing the change. Make a definitive statement that photography (with any annotations) is current and accurately depicts airport features (when applicable) and that any clearing or topping of trees/grading of obstructing ground that has occurred since the date of photography.

17-5. DATA PROCESSING

(1). Hardware

(2). Software

(3). Methodologies

(4). Quality Reviews: Provide a brief summary of methods used to help ensure high quality data and details of any changes from the Survey and Quality Control Plan. List all problems found and discuss corrective action taken.

(5). File Naming Convention

(6). File Formats and Medium

17-6. ANALYSIS OF RESULTS

Discuss the results, especially any unusual circumstances or problems, any deviation from the Statement of Work, and/or any results that exceed specifications, including those already reported in weekly email status reports.

17-7. RECOMMENDATIONS

Include any suggestions for improving future work.

17-8. SIGNATURE BLOCK

The contractor's signature is required to indicate concurrence that all requirements have been met.

17-9. ANNEXES

The following annexes are required to be submitted in the Final Project Report.

- Annex 1, Airport Survey Diagrams: A map showing the outline of the runways and the survey network at the airport with GPS vectors and angles and distances observed.

CHAPTER 18. DELIVERABLES

The following must be delivered to the NGS POC, FAA Airport Surveying–GIS Program Manager, and the Airport Authority:

18-1. LABOR, EQUIPMENT, ETC.

The contractor will provide all labor, equipment, supplies, and materials to produce and deliver the products as required under these General Specifications.

18-2. SURVEYS AND QUALITY CONTROL PLAN

Before any field work begins, the contractor will submit to NGS OC, a Survey and Quality Control Plan covering all work (refer to Part 1, Chapter 5). NGS will review this plan as soon as possible and respond with an approval or comment letter (or email) as soon as possible, normally within 5 working days. Field work will begin after the contractor receives the approval letter (or email).

18-3. PROJECT STATUS REPORTS

The contractor will submit project status reports via email to the airport authority, FAA Airport Surveying–GIS Program Manager, and NGS/FAA POCs every week until the work is complete. These reports should be brief and contain the current information in the text of the email.

18-4. FINAL PROJECT REPORT

Submit a Final Project Report covering the Airport Obstruction Chart survey (refer to Part 3, Paragraph 18-4, Final Project Report). For each airport, the contractor will submit a Final Project Report summarizing the work performed under these General Specifications and the Statement of Work (SOW), including the survey methodologies used to perform the work and a description and analysis of the quality control performed (refer to Part 1, Chapter 5, Survey and

Quality Control Plan), description of the recovered/established geodetic control (Part 1, Paragraph 8-6, Reconnaissance), and discussion of any unusual circumstances, discrepancies, and deviations from these General Specifications or the SOW.

18-5. DIGITAL FILES

The contractor will submit all original and final data in digital files on CD-ROM. At the completion of the survey, the zipped archive file compiled in data logger (ADCAT) must also be submitted. This zipped archive file must include the following files in addition to any file containing data related to the survey:

(1). Data logger (ADCAT) output:
- (a). Input Exchange and Output Exchange Files
- (b). Temporary Exchange Files
- (c). Observation Logs (both Raw Observations and Direct Edits)
- (d). Obstruction Zone Analysis
- (e). Reports (Basis Check Report, Import/Output Status Reports, and Required Feature Class Report)
- (f). AOC Checklists
- (g). ASCII Input Files (CXG and GPS files)

(2). Additional files to be included in the zip file (ADCAT archive function):
- (a). Any electronic files containing data related to a survey project (charts, checklists, notes, etc.)
- (b). Field sketches, diagrams, and plans in PDF:
  - (i). New runway end point or new runway, displaced threshold, or stopway
  - (ii). New taxi area
  - (iii). New ramp area
  - (iv). All off-field electronic NAVAIDs
  - (v). Photo reference point
  - (vi). Graphics of the runway profile points (two runs – digital file)
  - (vii). Sketch (distance from the starting end) showing the locations of the profile points (digital file)
- (c). Digital images from hand-held camera:
  - (i). New runway end point, displaced threshold, and stopways
  - (ii). NAVAIDs
- (d). Raw GPS Observation files:
  - (i). Submit original raw GPS data files in both the manufactures download format and in RINEX II format
  - (ii). Binary files containing ionosphere modeling information
- (e). Final processed data files with format:
  - (i). If GPS, include vector reduction and adjustment files
  - (ii). All files necessary to recreate the project must be included
- (f). Geospatial Vector Files

18-6. TRANSMITTAL LETTER

In the data submission package, the contractor will include a transmittal letter listing all items submitted to NGS. One copy of the transmittal letter must be forwarded to NGS, one copy to the FAA Airport Surveying-GIS Program Manager and one with the deliverables package to the airport authority..