

Approach Procedures Draft Proposal



AIXM 5 Public Design Review
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The purpose of this presentation is to provide an overview of the Aeronautical Information Conceptual Model for Approach Procedures.

In this briefing, we'll work our way through the UML model discussing the concepts and the major data element.



What is an Approach Procedure?

(FAA) Approach procedures are identified as the functions for predetermining safe and practical methods of navigating aircraft that prescribe intended flight tracks, operational altitudes, and minimums.

(ICAO) A series of predetermined maneuvers by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en route obstacle clearance criteria apply.

KODIAK, ALASKA AL-1238 (FAA)

LOC/DME IADQ
110.9
Chon 46

APP CRS
252°

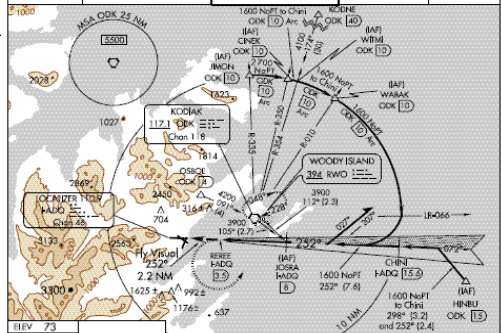
Rwy Hdg 7562
TDZE 27
Apt Elev 73

ILS or LOC Y RWY 25
KODIAK (A,D,Q)

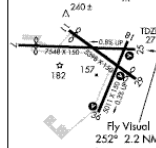
⚠ Circling NA west of runway 18-36. Circling to runway 29 and 36 NA north of runway 7-25. Circling NA at night, except runway 29. Rapidly rising terrain north, west and south of airport. Use IADQ DME when on localizer course. DME required for localizer retransmits. IS unusable from 2 DME inbound.

MISSED APPROACH: Climbing left turn to 2500 via heading 070° then climbing left turn to 3700 direct ODK VORTAC and hold.

ATIS 135.5 ANCHORAGE CENTER 125.1 281.4 KODIAK TOWER* 119.6 (CTAF) 239.0 GND CON 121.9 UNICOM 122.8



ELEV 73
Rwy 7 Hdg 5410°
Rwy 11 Hdg 4402°
Rwy 29 Hdg 4402°



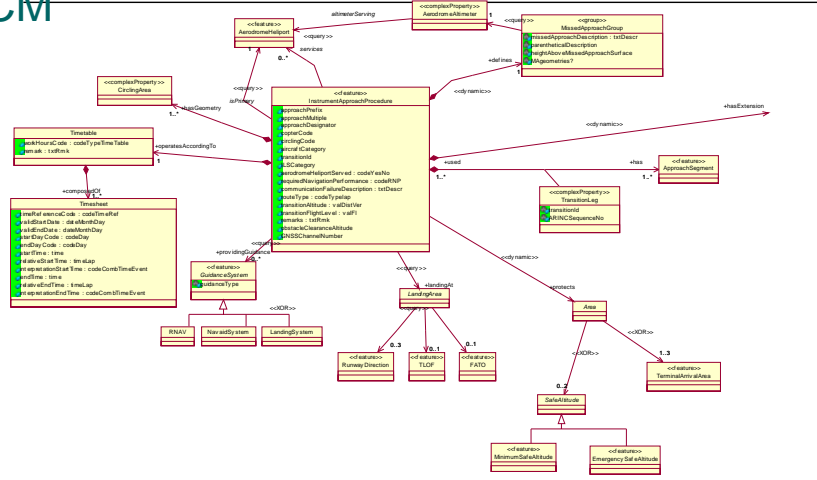
2500 3700 ODK VORTAC 117.1
RESE HADQ 3.3
JCSRA HADQ 1.5
1569 072° 3600
Fly Visual 252° 2.2 NM
Fly Visual 252° 2.2 NM
Fly Visual 252° 2.2 NM
Fly Visual 252° 2.2 NM

REIL	Rwys 25 and 36	0
HRI	Rwys 7-25, 11-29 and 18-36	0

Category	A	B	C	D
S-ILS 25	542-2	515 (500-7)	636-3 609 (600-3)	697-4 670 (700-4)
S-LOC 25	620-2	660-2 633 (600-2)	780-2-14 753 (800-2-14)	1120-3 1093 (1100-3)
CIRCLING	660-2	720-2 647 (700-2)	780-3 707 (800-3)	1120-4 1047 (1100-4)
	620-2	1060-2 547 (600-2)	1260-3 987 (1000-3)	1660-4 1187 (1600-4)

KODIAK, ALASKA
Chg#A 06047
57° 43' N-152° 30' W
KODIAK (A,D,Q)
ILS or LOC Y RWY 25

AICM



AIXM

```
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<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by Barbara Cordell (DOT/FAA/AJW313A) -->
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  <xsd:include schemaLocation="D:\schemas\barb aixm\AIXM-DataTypes.xsd"/>
  <xsd:include schemaLocation="D:\schemas\barb aixm\AIXM-AVN-DataTypes.xsd"/>
  <xsd:element name="Holding" type="HpnType">
    <xsd:annotation>
      <xsd:documentation>Comment describing your root element</xsd:documentation>
    </xsd:annotation>
  </xsd:element>
  <xsd:complexType name="Holding">
    <xsd:annotation>
      <xsd:documentation>Holding pattern at significant point</xsd:documentation>
    </xsd:annotation>
  </xsd:complexType>
</xsd:schema>
```



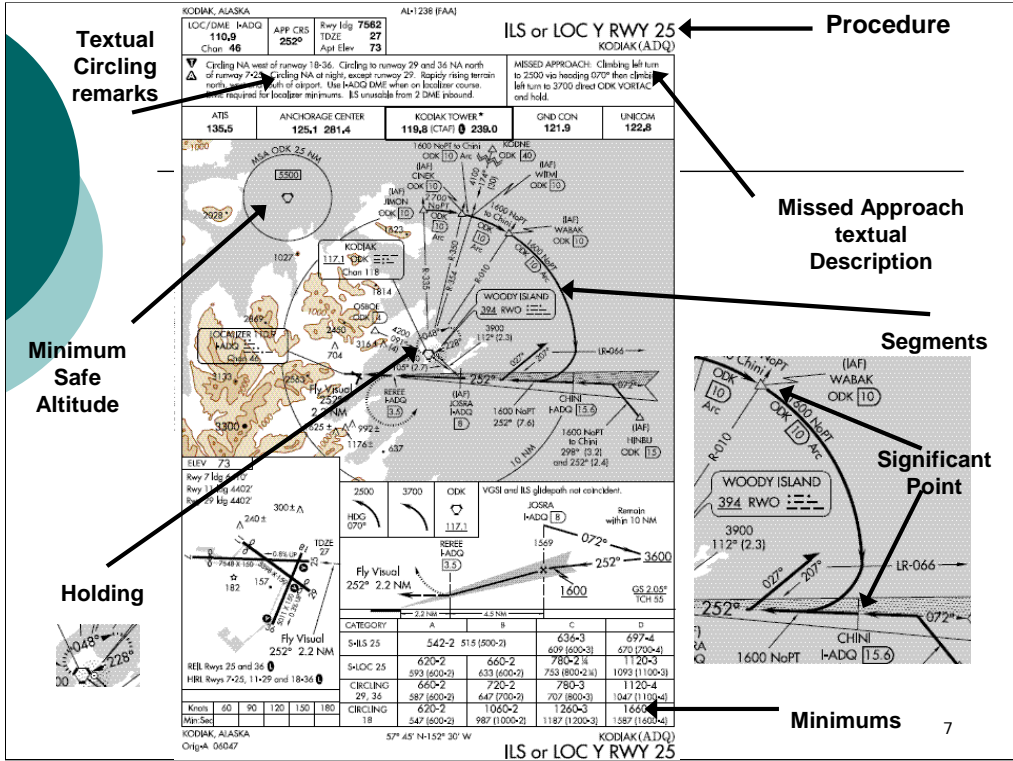
Overview

- Start with a high level overview
- Discuss the naming standards proposed to ICAO
- Briefly walk through different sections of an approach
 - Significant Points and ground references
 - Holding
 - Terminal Arrival Area (RNAV)
 - Minimum Safe/Sector Area and Emergency Safe Area
 - Segments
 - Circling
 - Minimums

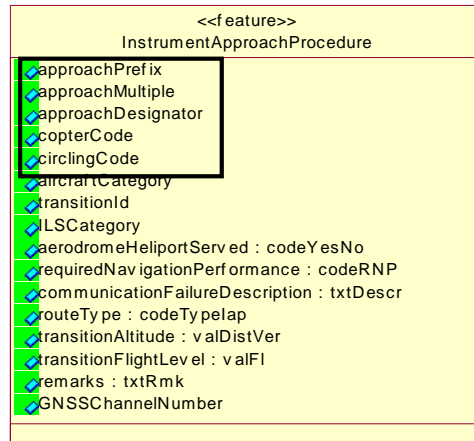
6

Using segments

Support latest PANS-OPS and TERPs requirements for RNAV procedures conventional procedures.



High Level Overview - Approach



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First 6 elements/attributes define the name of the approach procedure.

AerodromeHeliportServed is necessary for charting. This indicator is used to determine if the primary airport is actually an airport on the procedure or is it used for publishing the chart. Example is JFK helicopter procedure. This procedure does not service JFK airport but the procedure lies within the boundaries of the JFK air traffic management.

RequiredNavigationalPerformance is the lowest navigation performance (RNP) required for an aircraft to fly the Instrument Approach Procedure.

GNSSChannelNumber is Global Navigation Satellite System Channel number assigned to WAAS (Wide area augmentation system) and LAAS (Local area augmentation system) procedures



Proposed Naming Standard

- Two parts to the naming convention
 - Attributes common to all approaches
 - Attributes based on the type of Approach

Proposed Naming Standard

Base

Prefix
HI
COPTER
CONVERGING

Approach Types
VOR/DME NDB RNAV (GPS)

Multiple
Z
thru
A

Proposed Naming Standard

- Runway Landing

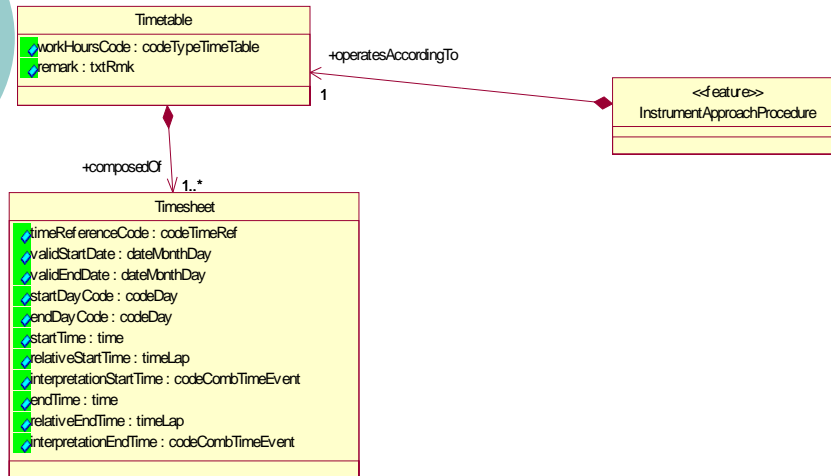
Runway		
Number	Parallel	Multiple
1	L	(Number)(Parallel)
thru	R	/
36	C	(Number)(Parallel)

Proposed Naming Standard

- Circling and Copter Landing

Circling	Copter
A	001
thru	thru
Z	360

High Level Overview -Timetable

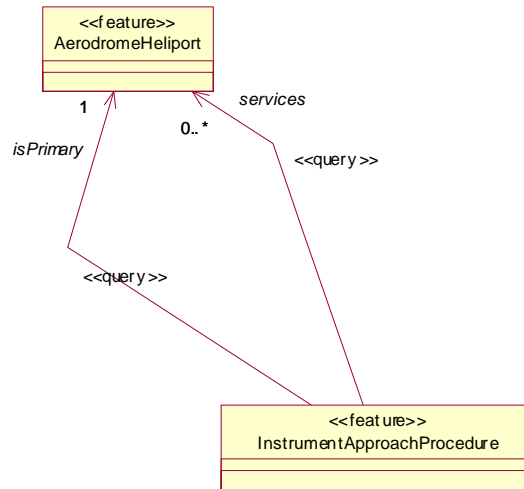


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This concept was introduced in previous versions of AIXM and carries forward in AIXM 5.0 but will be GML compatible.

Approach operates according to a time table. The approach may be available only during the day or Monday through Friday.

High Level Overview - Aerodrome

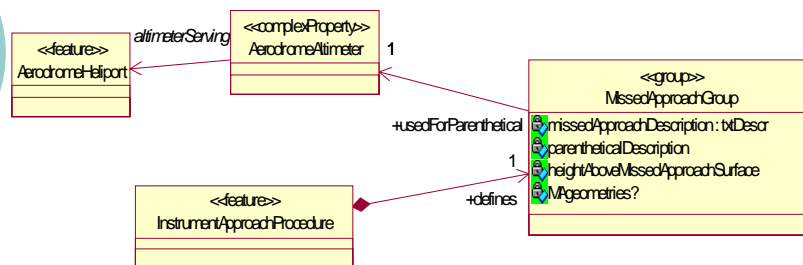


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We spoke earlier about the `AerodromeHeliportServed` attribute. The primary relationship is generally the airport which the approach procedure serves, however, an approach procedure can services multiple airports. We see this with helicopter point in space procedures.

The relationship is broken out only to handle the few procedures where the approach procedure does not service the primary airport listed.

High Level Overview – Missed Approach



MISSED APPROACH: Climbing left turn to 2500 via heading 070° then climbing left turn to 3700 direct ODK VORTAC and hold.

(6100 when using Denver/Stapleton altimeter setting)

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The missed approach group defines attributes that apply to the entire missed approach.

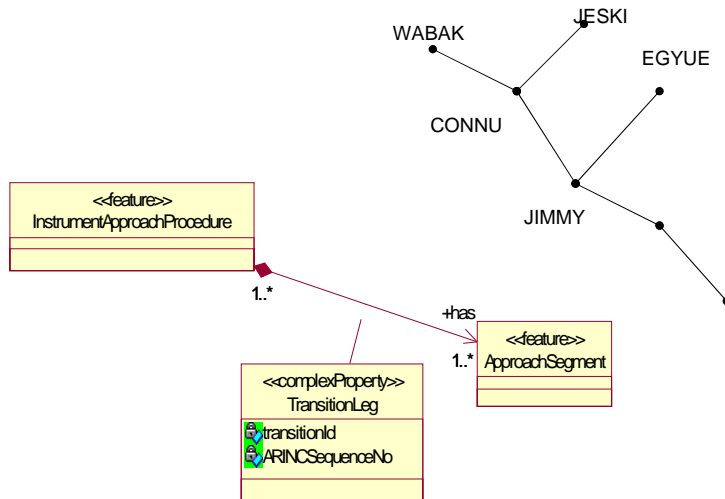
MissedApproachDescription is a textual description of the entire missed approach. The missed approach is also defined in segments.

Example: Climbing left turn to 2500 via heading 070 then climbing left turn to 3700 direct ODK Vortac and hold.

parentheticalDescription provides a second climb-to-altitude using the least accurate altimeter source by adding the difference between the RASS adjustments to the climb-to-altitude. Parentheticals are used when the 40:1 surface penetration can not be resolved by other methods. The instruction: Climb to 5900(6100 when using Denver/Stapleton altimeter setting) then

I've listed the altimeter as a separate class but may be represented as an Airport service.

High Level Overview – Transition and Segment

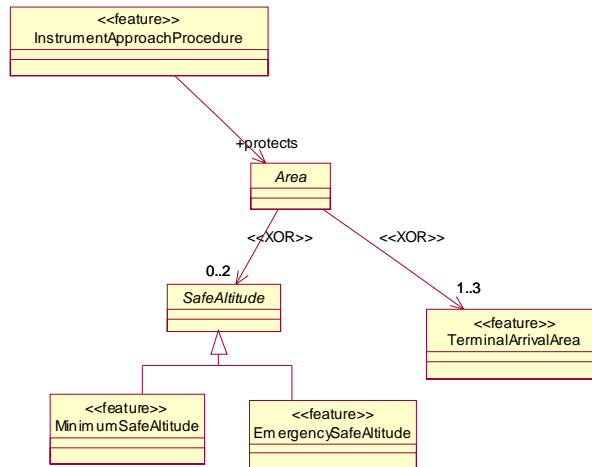


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Segments will be discussed later. The TransitionLeg is the association between the approach procedure and segments. A segment can be used on multiple transitions.

Transition is an ARINC 424 term. A transition is a combination of segments that take you from the enroute environment or vectored position to the Final Approach or the combination of segments defining the final and missed approach.

High Level Overview – MSA / TAA



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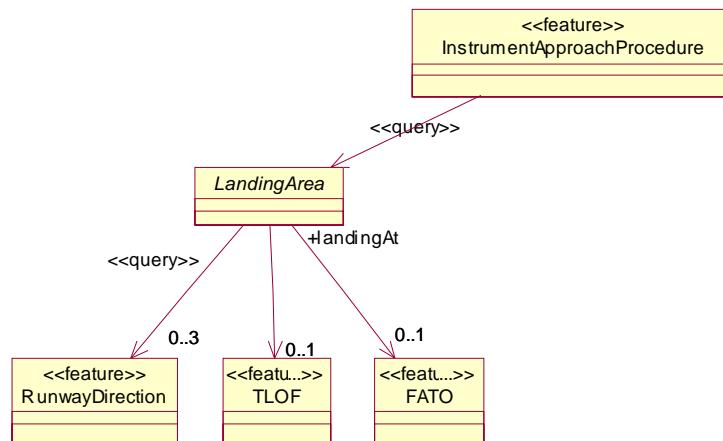
A procedure has protection areas.

The Area is an abstract class that is not implemented and is used to simplify the UML model. Minimum Safe/Sector Altitude and Emergency Safe Altitude are features discussed later but or not mutually exclusive. An approach procedure can have both.

MSA/ESA are altitudes depicted on approach charts which provide at least 1000 ft of obstacle clearance for emergency use within a specified distance from the navigation facility upon which the approach is predicated. MSA radius distance is usually 25 nautical miles. ESA is 100 nautical miles.

Terminal Arrival Altitudes (TAAs) are associated with an RNAV procedure. TAAs are used to transition from the en route to the terminal environment. TAAs will be discussed later as well.

High Level Overview – Landing Area



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Landing Area is an abstract class used to simplify the readability of the UML model. It is not implemented. An Approach is developed to transition the plane from the enroute environment of a vectored point in the terminal area to landing. Normally the final approach segment transitions the aircraft to one runway. In the case of parallel runways it can be used for all.

For helicopter approaches the landing areas are TLOF and FATO.

The touchdown and liftoff area (TLOF) is a load-bearing, generally paved area, normally centered in the FATO, on which the helicopter lands or takes off.

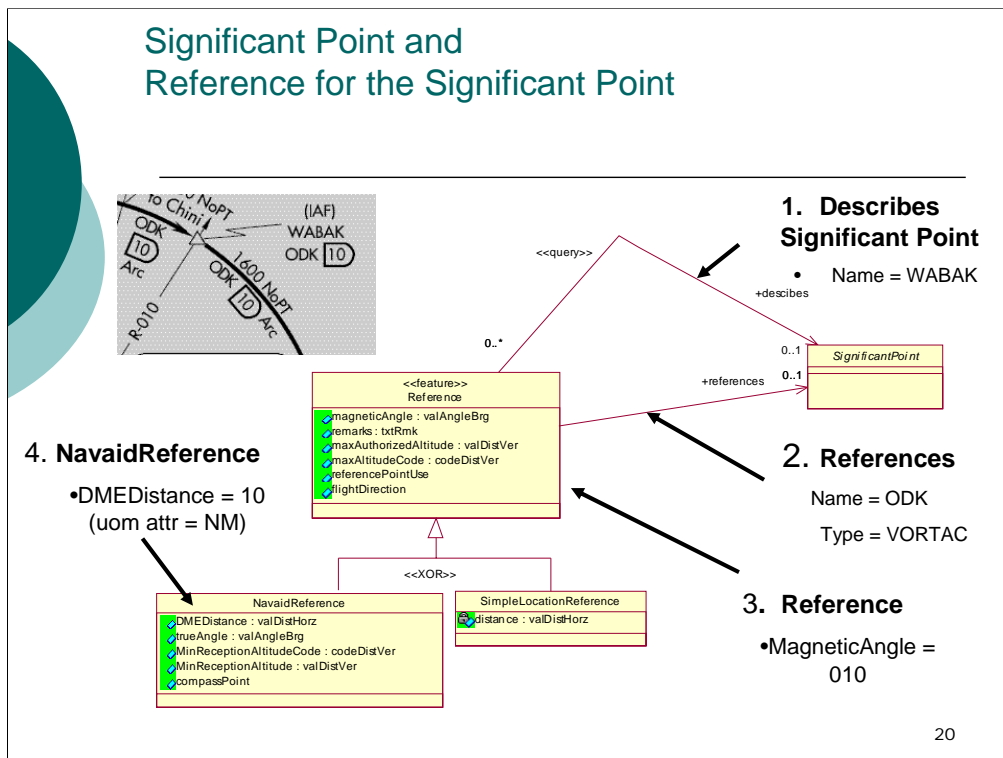
FINAL APPROACH AND TAKE-OFF AREA - A defined area over which the final phase of the approach to a hover, or a landing is completed and from which the takeoff is initiated.



Holding Extensions

- Briefly walk through different sections of an approach
 - Significant Points and ground references
 - Holding
 - Terminal Arrival Area (RNAV)
 - Minimum Safe/Sector Area and Emergency Safe Area
 - Segments
 - Circling
 - Minimums

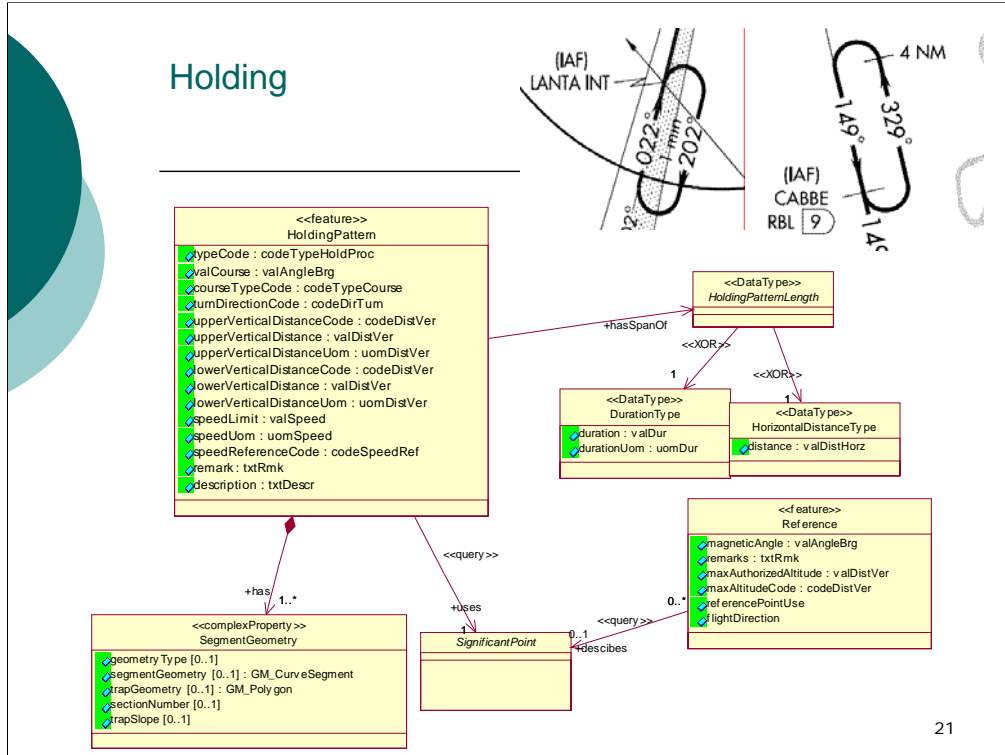
Significant Point and Reference for the Significant Point



A significant point is defined by ICAO as "a specified geographical location used to define an ATS route, the flight path of an aircraft or for other navigation/ATS purposes".

A point on a procedure can be a named point such as a navaid or fix or it can be described by one or more distance(s) and/or radial(s) from a ground point.

An example of a Waypoint (a point used during satellite navigation guided by lat/long) is Funny WP or WACKO WP. This point is not described any further. A couple of examples of points that are named but reference ground objects are TULLU / 5.6 DME from ABC Vortac or SMITH INT



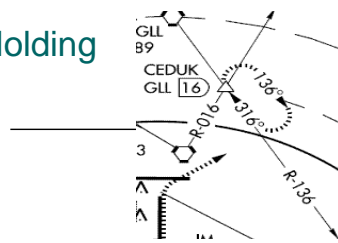
If a holding pattern is used on an RNAV procedure then it will not have a reference to a ground based navaid. If the pattern is flown conventionally it will have a reference to a navaid.

The geometry is the holding pattern template. This is used during Obstacle evaluation, flight check and recently been requested for displaying in the cockpit. The flight management system will alert the pilot if the aircraft is moving outside of the protected area.

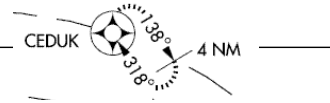
HoldingPatternLength is an abstract class. The length of holding can be defined by a time or distance. DurationType is time and DistanceType is distance.

Holding with right turn is considered Standard holding.

Holding



- Significant Point = CEDUK
- Reference = GLL VORTAC
 - Typecode = enroute/terminal
 - Course = 136
 - courseTypeCode = Radial
 - Direction = NE
 - turnDirection = R
 - UpperVerticalDistance = 8000
 - LowerverticalDistance = 3000
 - Duration = 1

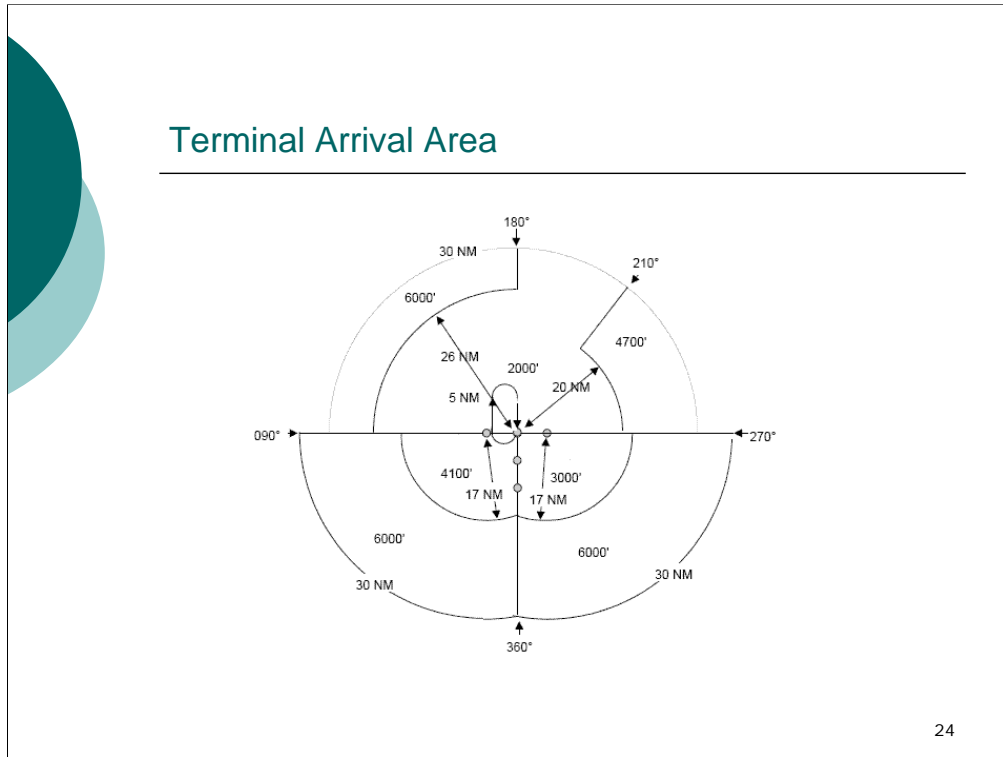


- Significant Point = CEDUK
- Reference = not defined
 - Typecode = enroute/terminal
 - Course = 318
 - courseTypeCode = Course
 - Direction = NE
 - turnDirection = R
 - UpperVerticalDistance = 8000 Ft
 - LowerverticalDistance = 3000
 - Distance = 4



Holding Extensions

- Climb in hold
- Reason for non standard holding
- Speed evaluation
- Controlling obstacles



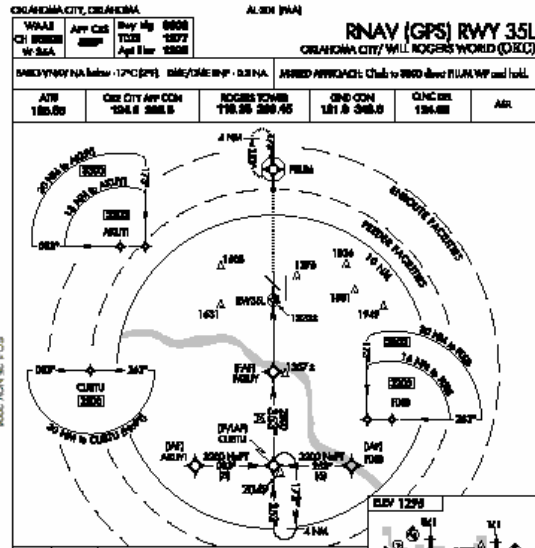
There are three areas that make up an approach procedure terminal arrival; left based, right based and straight in areas. TAA lateral boundaries are defined by the extension of the left and right base initial segments.

The TAA reference points are the initial approach and/or intermediate fixes. The outer area boundaries are determined by arc radius centered on each of the three reference points.

Each TAA / TAA sector is surrounded by a buffer area. Sectors must provide appropriate required obstacle clearance within the sector boundaries and over all obstacles within the buffer area.

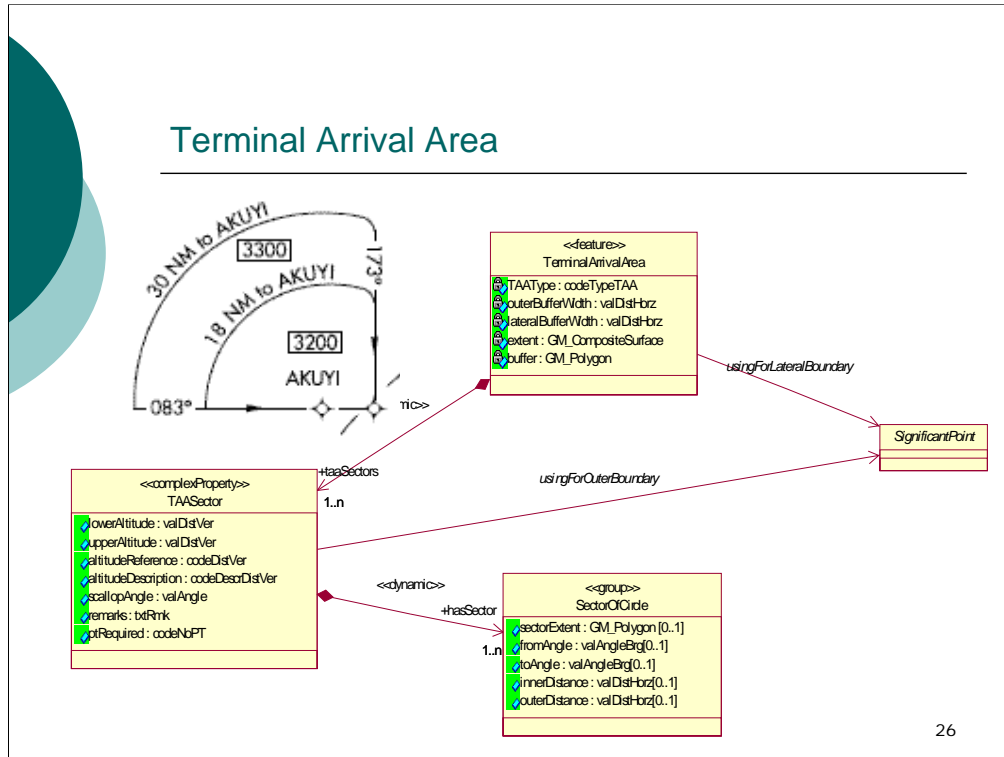
The straight-in TAA area may be divided radially into sub-sectors. Each sector may be further sub-divided by a single stepdown arc centered on the IF(IAF). The minimum size of any straight-in TAA sub-sector that also contains a step-down arc shall be no less than 45 arc degrees. The minimum size of any straight-in TAA sub-sector that does not contain a step-down arc shall not be less than 30 arc degrees. Left and right TAA base areas may only have step-down arcs, and shall not be further divided into radial sub-sectors.

Terminal Arrival Area



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Terminal Arrival Area



TaaType = straight in, left base, or right base

Extent = the collection of the sectors within an area

Buffer = is the extra protection area around each area

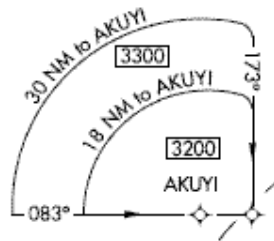
When necessary to accommodate terrain diversity, operational constraints, or excessive descent gradients, the straight-in, left, and right base areas may be subdivided or sectored.

A TAASector can represent:

- an entire Straight-in, left base or right base area if there are no sectors and/or stepdowns
- a stepdown area
- a sector
- sections of a sector
- a stepdown within a sector

SectorofCircle is a grouping of attributes that define the circle. Within it is the Geometry.

Terminal Arrival Area



•Significant Point

- Name = AKUYI

•TerminalArrivalArea

- taaType = s,r,l
- Extent = picture of drawing
- Buffer = buffer geometry around drawing

•TaaSector – 2

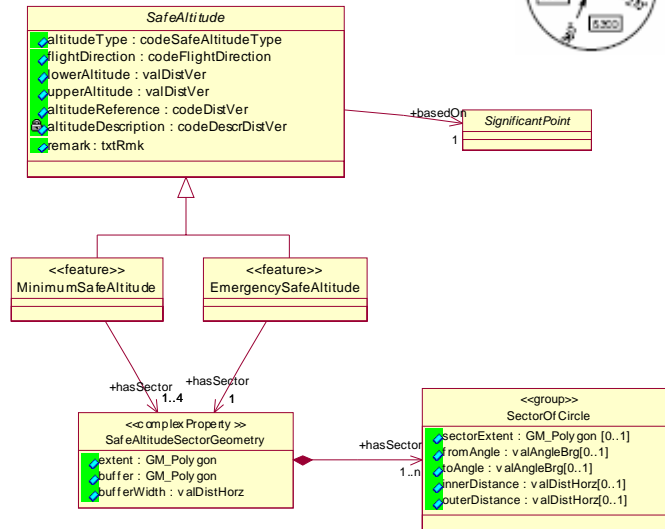
- lowerAltitude = 3200

•SectorofCircle

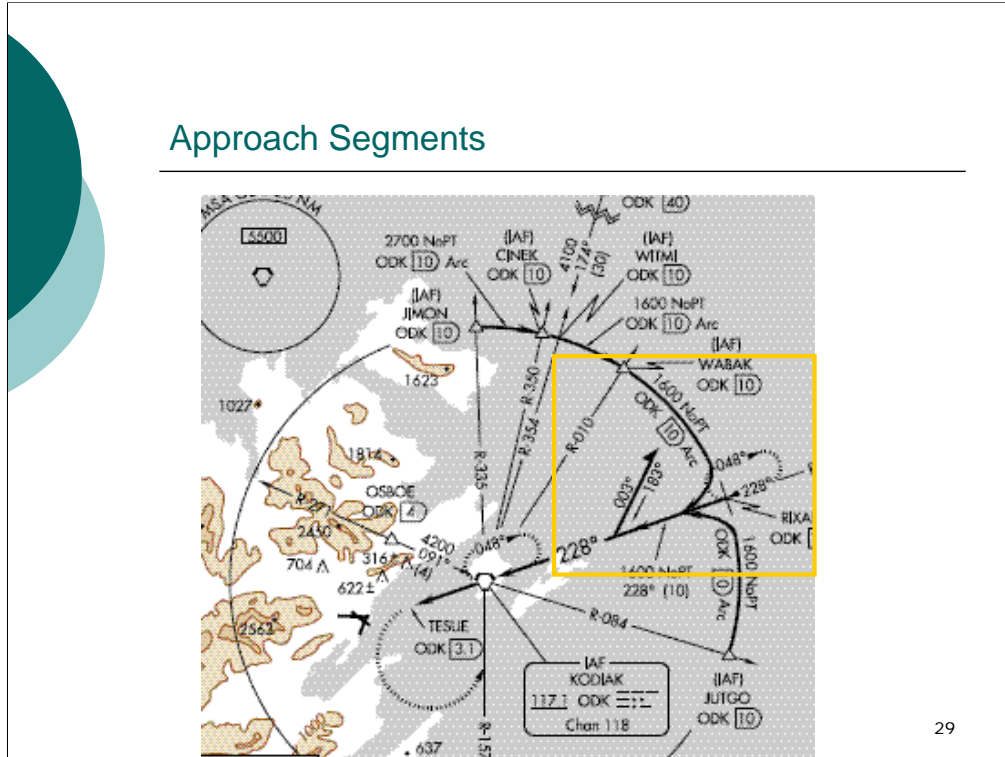
- sectorExtent = geometry of the sector
- fromAngle = 083
- toAngle = 173
- Innerdistance = 0
- outerDistance = 18

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MSA/ESA



Approach Segments

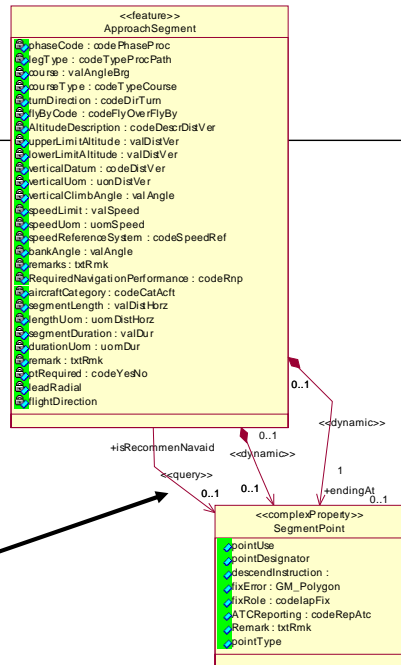


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Point out CINEK to RIXAE, obstacles on chart, center point for ARC, descriptions for significant points

Approach Segments

- Define Segment Points
 - Point type – start and end
 - Fix role – for start (IAF) for end (IF)
- Define WABAK /ODK R-010 10DME
- Define RIXAE/ODK R-228 10 DME
- Define Approach Segment Attributes



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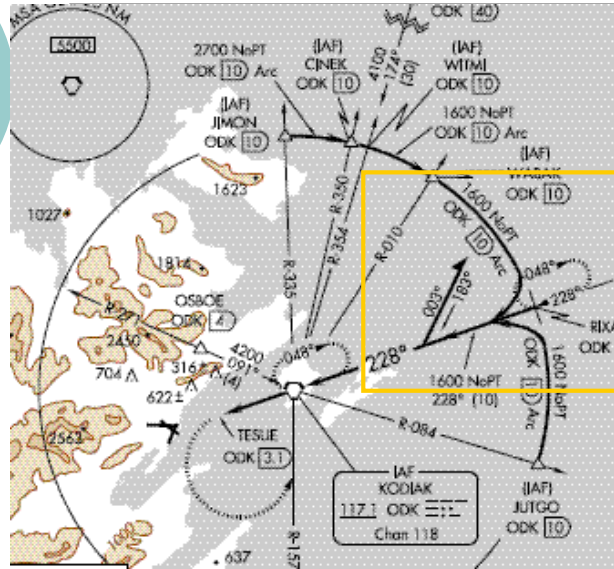
FC, CF and PI leg types will need a recommended navaid.

FC - from fix on a specified course to a specified distance

CF - specified course to a fix

PI - procedure turn (course reversal starting at a fix)

Approach Segments



- legType = RF
- CourseType = track
- turnDirection = R
- flyByCode = FB
- lowerLimitAltitude = 1600
- ptRequired = N

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Point out CINEK to RIXAE, obstacles on chart, center point for ARC, descriptions for significant points



Approach Segments

- Handled named and unnamed fixes
- But what about segments that end at the Glideslope, MAP or Decision Altitude

Recommendation (Something to ponder)

Add new type of Significant Point

Point designator

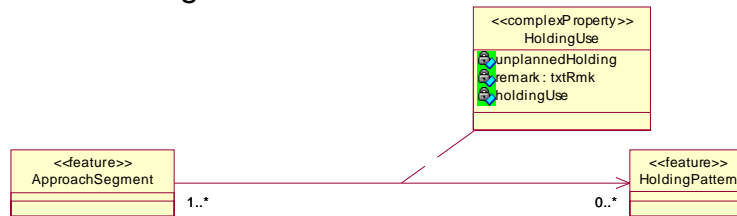
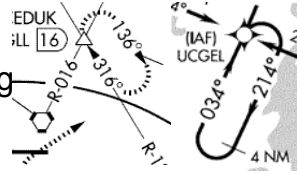
standard enumeration list

Alternative

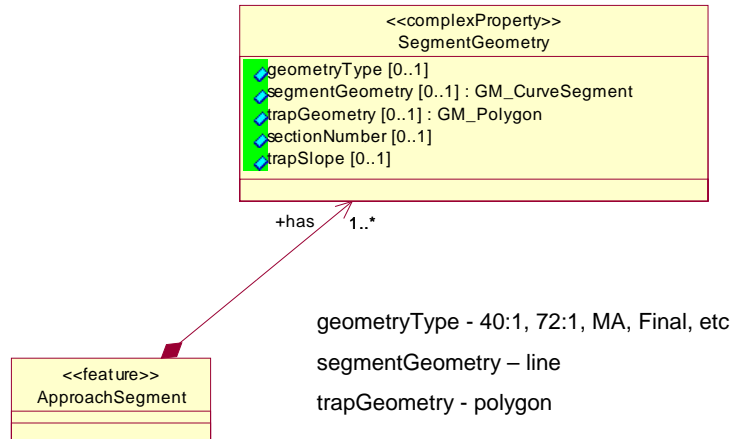
Legtype

Approach Segments

- Missed Approach Holding
- In lieu of Procedure Turn
- Arrival Holding

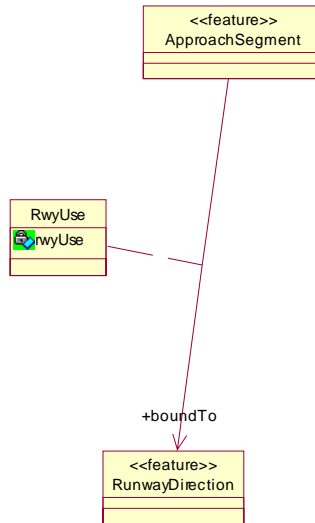


Approach Segments



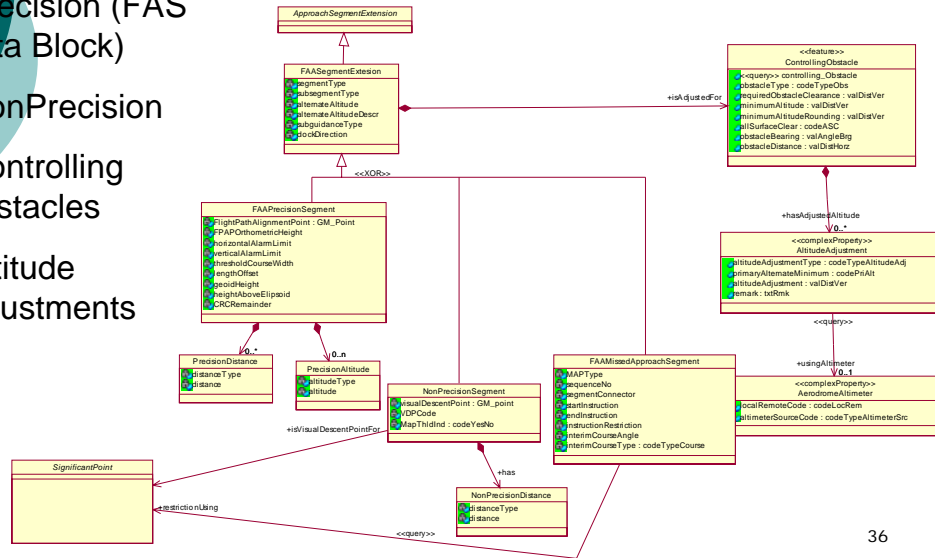
Sidestep and Circling to specific runway

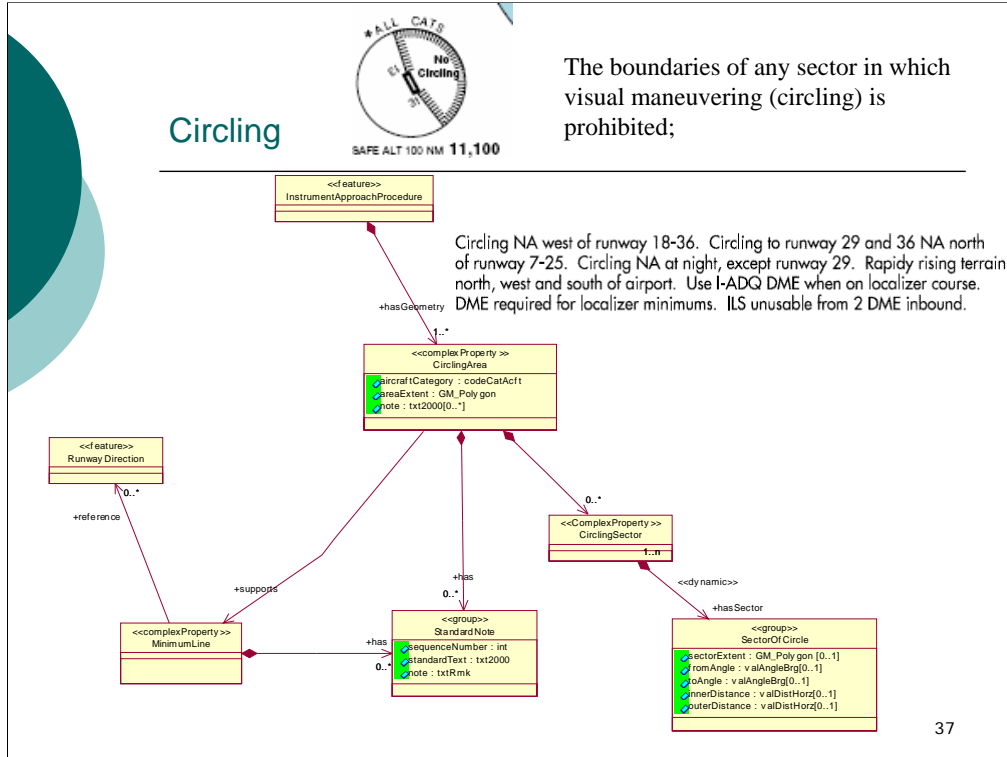
- Relationship use:
- Sidestep



Segment Extension

- Precision (FAS Data Block)
- NonPrecision
- Controlling Obstacles
- Altitude Adjustments



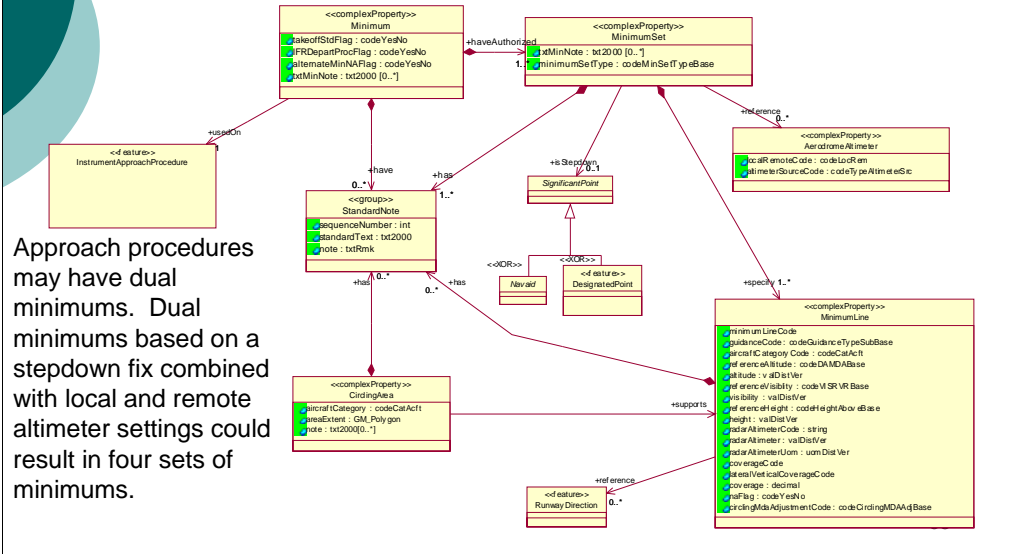


ICAO requirement (see item 11.10.6) to depict on the chart "f) the boundaries of any sector in which visual manoeuvring (circling) is prohibited;" I think that I have seen European charts that have this little 'no circling' diagram.

Circling NA west of rwy 18/36.

Minimums

CATEGORY	A	B	C	D
S-ILS 25	542-2	515 (500-2)	636-3 609 (600-3)	697-4 670 (700-4)
S-LOC 25	620-2 593 (600-2)	660-2 633 (600-2)	780-2 1/4 753 (800-2 1/4)	1120-3 1093 (1100-3)
CIRCLING 29, 36	660-2 587 (600-2)	720-2 647 (700-2)	780-3 707 (800-3)	1120-4 1047 (1100-4)
CIRCLING 18	620-2 547 (600-2)	1060-2 987 (1000-2)	1260-3 1187 (1200-3)	1660-4 1587 (1600-4)



Approach procedures may have dual minimums. Dual minimums based on a stepdown fix combined with local and remote altimeter settings could result in four sets of minimums.

Obstacle clearance is a primary safety consideration in the development of instrument approach procedures. From the operational point of view, it is stressed that the obstacle clearance applied in the development of each instrument approach procedure is considered to be the minimum required for an acceptable level of safety in operations.

Minima are developed by adding the effect of a number of operational factors to Obstacle Clearance Altitude/Height to produce, in the case of precision approaches, decision altitude (DA) or decision height (DH) and, in the case of nonprecision approaches, minimum descent altitude (MDA) or minimum descent height (MDH).

There types of minimum lines:

- Straight In
- Circling
- Sidestep

Approach procedures may have dual minimums. Dual minimums based on a stepdown fix combined with local and remote altimeter settings could result in four sets of minimums.

The authorized minimums apply to both day and night conditions unless otherwise restricted. When night minimums are not authorized or are higher than day minimums, restrictions are noted.

Minimums

CATEGORY	A	B	C	D
S-ILS 25	542-2	515 (500-2)	636-3 609 (600-3)	697-4 670 (700-4)
S-LOC 25	620-2 593 (600-2)	660-2 633 (600-2)	780-2 ¼ 753 (800-2 ¼)	1120-3 1093 (1100-3)
CIRCLING 29, 36	660-2 587 (600-2)	720-2 647 (700-2)	780-3 707 (800-3)	1120-4 1047 (1100-4)
CIRCLING 18	620-2 547 (600-2)	1060-2 987 (1000-2)	1260-3 1187 (1200-3)	1660-4 1587 (1600-4)

MDA
Military Use
HAA

HAT
DH
Visibility

A
B
C
D

aftCategoryCode
HAT
DH
Visibility

MDA
Military Use
HAA

Types of minimum lines:

Straight In

Circling

Sidestep

Approach procedures may have dual minimums. Dual minimums based on a stepdown fix combined with local and remote altimeter settings could result in four sets of minimums.

The authorized minimums apply to both day and night conditions unless otherwise restricted.

When night minimums are not authorized or are higher than day minimums, restrictions are noted.



Approach Procedures Summary

- Approach at a high level
- Significant Points and Reference
- Holding (three types) and how they relate to a segment
- Terminal Arrival Areas
- Minimum Safe/Sector Altitude / Emergency Safe Altitudes
- Transition and Segments
- Circling
- Minimums

The End



AIXM 5 Public Design Review
February 7-8, 2006
Washington DC

Approach Segments

```
<<feature>>
  ApproachSegment
  phaseCode : codePhaseProc
  legType : codeTypeProcPath
  course : valAngleBrg
  courseType : codeTypeCourse
  turnDirection : codeDirTurn
  flyByCode : codeFlyOverFlyBy
  AltitudeDescription : codeDescrDistVer
  upperLimitAltitude : valDistVer
  lowerLimitAltitude : valDistVer
  verticalDatum : codeDistVer
  verticalUom : uomDistVer
  verticalClimbAngle : valAngle
  speedLimit : valSpeed
  speedUom : uomSpeed
  speedReferenceSystem : codeSpeedRef
  bankAngle : valAngle
  remarks : txtRmk
  RequiredNavigationPerformance : codeRnp
  AircraftCategory : codeCatAct
  segmentLength : valDistHorz
  lengthUom : uomDistHorz
  segmentDuration : valDur
  durationUom : uomDur
  remarks : txtRmk
  ptRequired : codeYesNo
  leadRadial
  flightDirection
```

- legType = RF
- CourseType = Tangential track
- turnDirection = R
- flyByCode = FB
- lowerLimitAltitude = 1600
- ptRequired = N



Defining an intersection

- Define Describing Significant Point

- Describes Significant Point

- Name = WACKO

- Define referencing Navaid
- Define along Track reference
- Define the crossing reference(s)

- References Navaid

- Name = ABC
- Type = VOR/DME

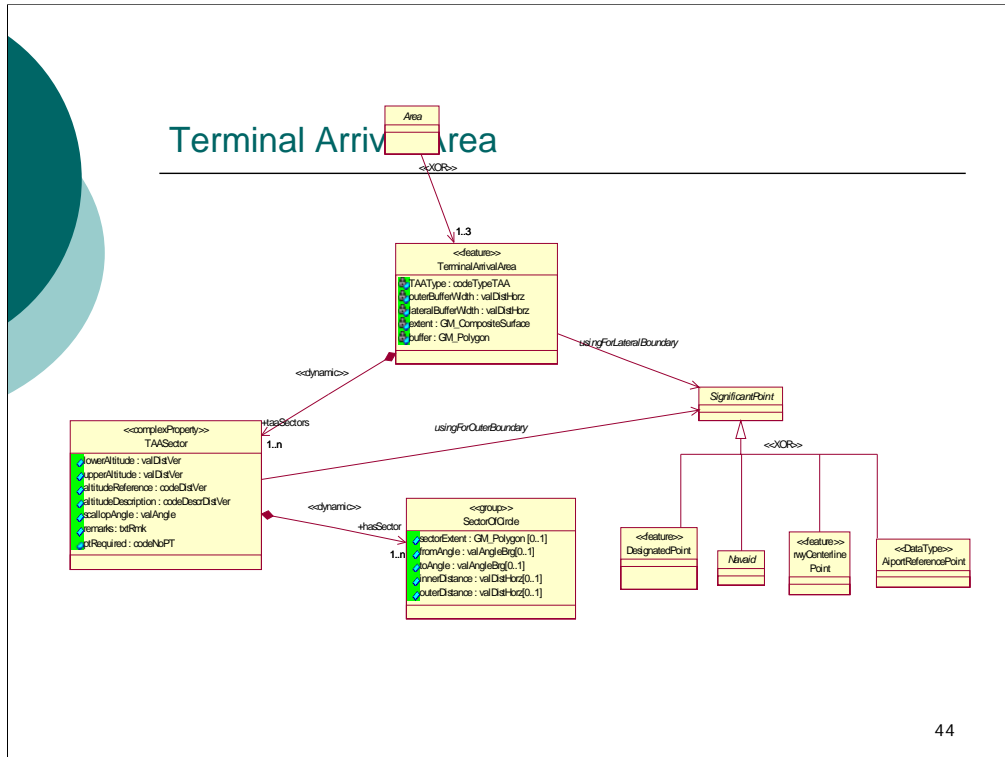
- Reference

- MagneticAngle = 45
- referencePointUse = Along Track

- NavaidReference

- DMEDistance = 3.5 (uom attr = NM)

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A terminal arrival area can be based on a navaid, a designated point, the runway threshold (in AIXM is a centerline point) or an airport reference point

Approach Segments

FROM	TO	COURSE AND DISTANCE	ALTITUDE
KODNE/ODK 40.00 DME	WITMI/ODK 10.00 DME	173.91/30.00 (ODK R-354)	4100
OSBOE/ODK 4.00 DME	ODK VORTAC	091.07/4.00	4200
JIMON/ODK 10.00 DME CW (IAF)	CINEK/ODK 10.00 DME (NOPT)	10.00 DME ARC	2700
CINEK CW (IAF)	RIXAE/ODK 10.00 DME (NOPT)	10.00 DME ARC	1600
WITMI CW (IAF)	RIXAE (NOPT)	10.00 DME ARC	1600
WABAK/ODK 10.00 DME CW (IAF)	RIXAE (NOPT)	10.00 DME ARC	1600
JUTGO/ODK 10.00 DME CCW (IAF)	RIXAE (NOPT)	10.00 DME ARC	1600