



ICAO PARIS UNITING AVIATION

ICAO Requirements on Terrain and Obstacle Datasets (TOD)

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TOD Workshop

(Algiers, Algeria, 29-30 October 2019)



- History of TOD Provisions
- Intended Use of TOD
- Area 4: Coverage, Availability, data specifications
- Area 3: Coverage, Availability, data specifications
- Area 2: Coverage, Availability, data specifications, exceptions
- Area 1: Coverage, Availability, data specifications
- Terrain/Obstacle Data attributes
- Terrain/Obstacle Data specifications
- TOD Provisions in GANP



Amendment 33 to Annex 15 (effective 12 July 2004)

Mandated Area 1 applicable 20 November 2008
Mandated area 4 (for all aerodromes) applicable 20 November 2008
Mandated Area 2 and 3 (for all aerodromes) applicable 18 November 2010

Amendment 36 to Annex 15 (effective 12 July 2010)

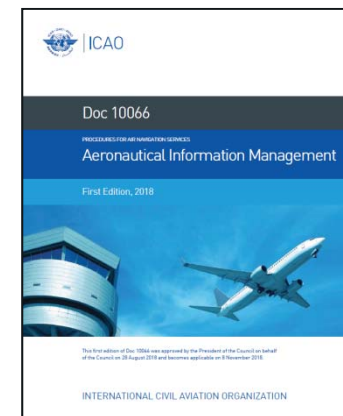
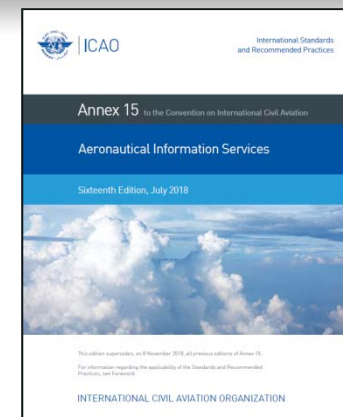
Modified area 2 (into 2a, 2b, 2c and 2d)
Modified the mandates as follows:
Mandated Area 1 & 4 (for CAT II/III aerodromes regularly used by international civil aviation)
Mandated area 2a, including TKOF flight path area & OLS (for aerodromes regularly used by international civil aviation) applicable **12 November 2015** (postponed)
Recommended Area 2 (b, c, d) and 3 (for aerodromes regularly used by international civil aviation)

Amendment 37 to Annex 15 (effective 15 July 2013)

Applicable 14 November 2013 (no significant change)
Minor modification in the description of area 2 supplements (TKOF flight path area & OLS)

Amendment 40 to Annex 15 (effective 16 July 2018)

Applicable 8 November 2018 (no significant change in TOD provisions)
Restructured Annex 15: TOD categorized as digital datasets (together with AIP dataset, aerodrome mapping datasets and instrument flight procedure datasets)
PANS AIM (First Edition) was released included some TOD provisions





Intended Use of Terrain and Obstacle Datasets

- a) Ground Proximity Warning System (GPWS) with Forward Looking Terrain Avoidance (FLTA) function and minimum safe altitude warning (MSAW) system;
- b) Determination of contingency procedures for use in the event of an emergency during a missed approach or take-off;
- c) Aircraft operating limitations analysis;
- d) Instrument procedure design (including circling procedure);
- e) Determination of en-route “drift-down” procedure and en-route emergency landing location;
- f) Advanced Surface Movement Guidance and Control System (A-SMGCS);
- g) aeronautical chart production and on-board databases.

Other usages:

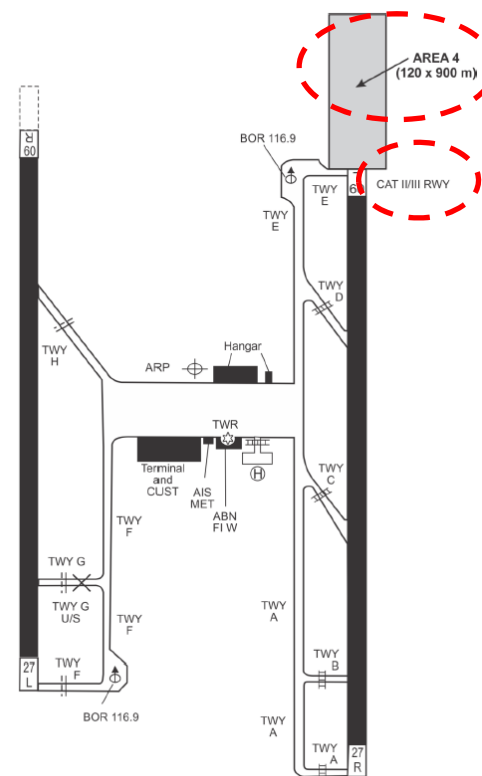
- *training/flight simulator*
- *synthetic vision systems*
- *determining the height restriction or removal of obstacles*



Area 4: Coverage and Availability

- **Coverage:** the area extending 900 m prior to the runway threshold and 60 m each side of the extended runway centre line in the direction of the approach on a precision approach runway, Category II or III.
- **Availability:**
 - **Terrain:** for aerodromes regularly used by international civil aviation, terrain data shall be provided for Area 4 for all runways where precision approach Category II or III operations have been established and where detailed terrain information is required by operators to enable them to assess the effect of terrain on decision height determination by use of radio altimeters
 - **Obstacles:** for aerodromes regularly used by international civil aviation, obstacle data shall be provided for Area 4 for all runways where precision approach Category II or III operations have been established.

Area 4 terrain and obstacles






- Area 4 Terrain data specifications:

Post spacing	0.3 arc seconds (approx. 9 m)
Vertical accuracy	1 m
Vertical resolution	0.1 m
Horizontal accuracy	2.5 m
Confidence level	90%
Integrity classification	essential
Maintenance period	as required

- Area 4 Obstacle data specifications:

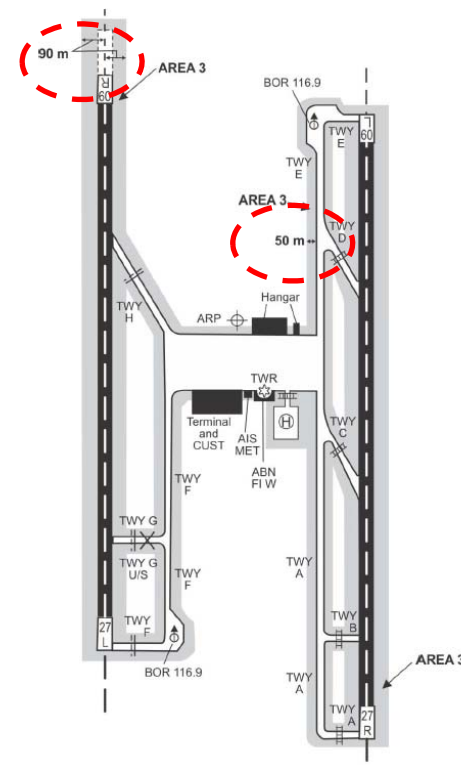
Vertical resolution (Pub.)	0.1 m
Vertical accuracy	1 m
Horizontal accuracy	2.5 m
Orig type	Surveyed
Integrity classification	essential

Definitions of data specifications aspects 

Area 3: Coverage and Availability

- **Coverage:** the area bordering an aerodrome movement area that extends horizontally from the edge of a runway to 90 m from the runway centre line and 50 m from the edge of all other parts of the aerodrome movement area
- **Availability:**
 - **Terrain: Recommendation.**— For aerodromes regularly used by international civil aviation, terrain data should be provided for Area 3
 - **Obstacles: Recommendation.**— For aerodromes regularly used by international civil aviation, obstacle data should be provided for Area 3 for obstacles that penetrate the relevant obstacle data collection surface extending a half-meter (0.5 m) above the horizontal plane passing through the nearest point on the aerodrome movement area

Area 3 terrain and obstacles





- Area 3 Terrain data specifications:

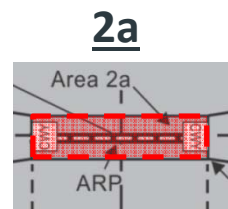
Post spacing	0.6 arc seconds (approx. 20 m)
Vertical accuracy	0.5 m
Vertical resolution	0.01 m
Horizontal accuracy	0.5 m
Confidence level	90%
Integrity classification	essential
Maintenance period	as required

- Area 3 Obstacle data specifications:

Vertical resolution (Pub.)	0.1 m or 0.1 ft
Horizontal resolution (Pub.)	1/10 sec
Vertical resolution (Chart)	1m or 1 ft
Horizontal resolution (Chart)	1/10 sec
Vertical accuracy	0.5 m
Horizontal accuracy	0.5 m
Orig type	Surveyed
Integrity classification	essential

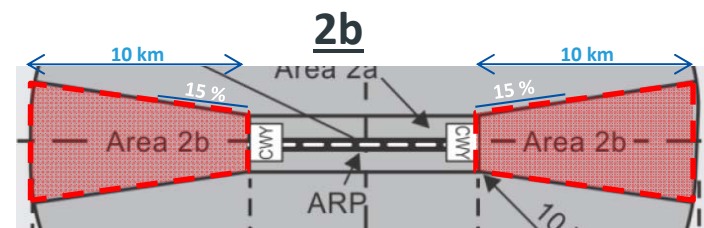


- Coverage: within the vicinity of an aerodrome, subdivided as follows:
 - **Area 2a**: a rectangular area around a runway that comprises the runway strip plus any clearway that exists;



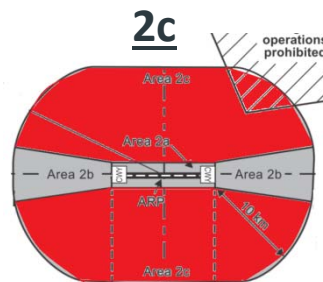


- Coverage: within the vicinity of an aerodrome, subdivided as follows:
 - Area 2a: a rectangular area around a runway that comprises the runway strip plus any clearway that exists;
 - Area 2b: an area extending from the ends of Area 2a in the direction of departure, with a length of 10 km and a splay of 15 per cent to each side;



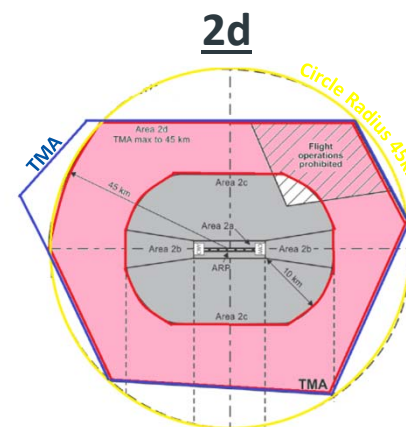


- Coverage: within the vicinity of an aerodrome, subdivided as follows:
 - Area 2a: a rectangular area around a runway that comprises the runway strip plus any clearway that exists;
 - Area 2b: an area extending from the ends of Area 2a in the direction of departure, with a length of 10 km and a splay of 15 per cent to each side;
 - Area 2c: an area extending outside Area 2a and Area 2b at a distance of not more than 10 km from the boundary of Area 2a; and



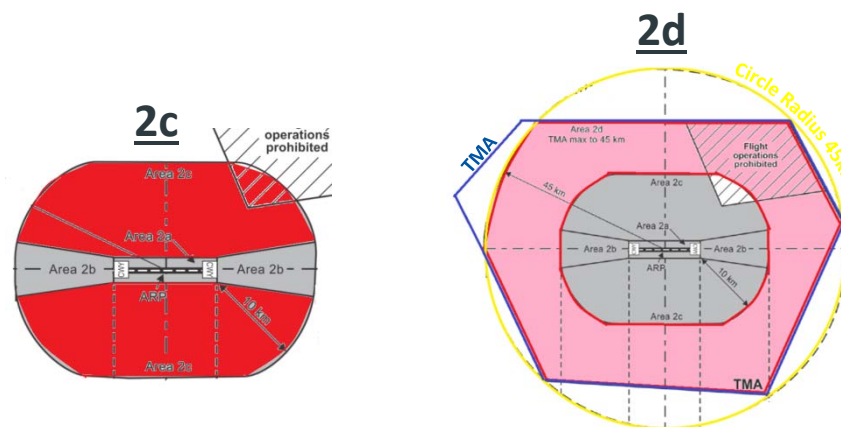
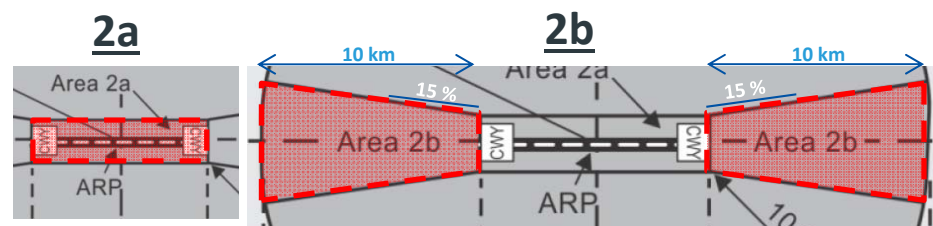


- Coverage: within the vicinity of an aerodrome, subdivided as follows:
 - Area 2a: a rectangular area around a runway that comprises the runway strip plus any clearway that exists;
 - Area 2b: an area extending from the ends of Area 2a in the direction of departure, with a length of 10 km and a splay of 15 per cent to each side;
 - Area 2c: an area extending outside Area 2a and Area 2b at a distance of not more than 10 km from the boundary of Area 2a; and
 - Area 2d: an area outside Areas 2a, 2b and 2c up to a distance of 45 km from the aerodrome reference point, or to an existing terminal control area (TMA) boundary, whichever is nearest



- Coverage: within the vicinity of an aerodrome, subdivided as follows:

- **Area 2a:** a rectangular area around a runway that comprises the runway strip plus any clearway that exists;
- **Area 2b:** an area extending from the ends of Area 2a in the direction of departure, with a length of 10 km and a splay of 15 per cent to each side;
- **Area 2c:** an area extending outside Area 2a and Area 2b at a distance of not more than 10 km from the boundary of Area 2a; and
- **Area 2d:** an area outside Areas 2a, 2b and 2c up to a distance of 45 km from the aerodrome reference point, or to an existing terminal control area (TMA) boundary, whichever is nearest






Terrain data

- For aerodromes regularly used by international civil aviation, terrain data shall be provided for:
 - a) Area 2a;
 - b) the take-off flight path area; and
 - c) an area bounded by the lateral extent of the aerodrome obstacle limitation surfaces
- **Recommendation.**— *For aerodromes regularly used by international civil aviation, terrain data should be provided for within Area 2 as follows:*
 - a) *in the area extending to a 10-km radius from the ARP; and*
 - b) *within the area between 10 km and the TMA boundary or a 45-km radius (whichever is smaller), where terrain penetrates a horizontal terrain data collection surface specified as 120 m above the lowest runway elevation.*

Take-off Flight Path &
Obstacle Limitation Surf



Obstacle data

- For aerodromes regularly used by international civil aviation, obstacle data shall be provided for:
 - a) Area 2a (obstacle collection surface shall have a height of 3 m above the nearest runway elevation measured along the runway centre line, and for those portions related to a clearway, if one exists, at the elevation of the nearest runway end);
 - b) objects in the take-off flight path area which project above a plane surface having a 1.2 per cent slope and having a common origin with the take-off flight path area;
 - c) penetrations of the aerodrome obstacle limitation surfaces.
- **Recommendation.**— *For aerodromes regularly used by international civil aviation, obstacle data should be provided for Areas 2b, 2c, 2d*
(data need not be collected for obstacles less than a 3 m above ground in Area 2b and less than a 15 m above ground in Area 2c.)
- For aerodromes regularly used by international civil aviation, obstacle data shall be provided for all obstacles within Area 2 that are assessed as being a hazard to air navigation



- Area 2 Terrain data specifications:

Post spacing	1 arc seconds (approx. 30 m)
Vertical accuracy	3 m
Vertical resolution	0.1 m
Horizontal accuracy	5 m
Confidence level	90%
Integrity classification	essential
Maintenance period	as required

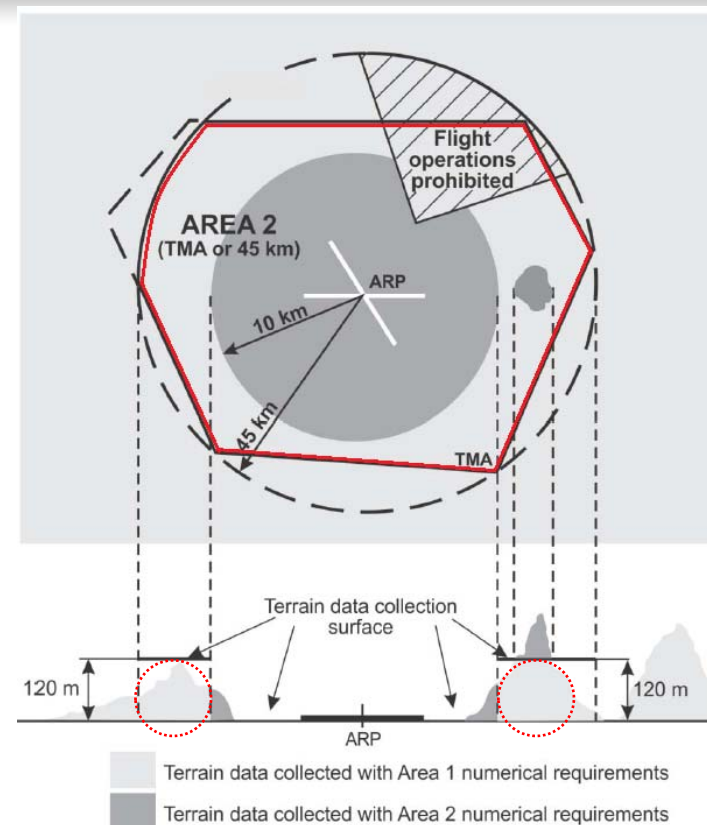
- Area 2 Obstacle data specifications:

Vertical resolution (Pub.)	1 m or 1 ft
Horizontal resolution (Pub.)	1/10 sec
Vertical resolution (Chart)	1 m or 1 ft
Horizontal resolution (Chart)	1/10 sec
Vertical accuracy	3 m
Horizontal accuracy	5 m
Orig type	Surveyed
Integrity classification	essential

Exceptions in Area 2 Data Specifications

Terrain data

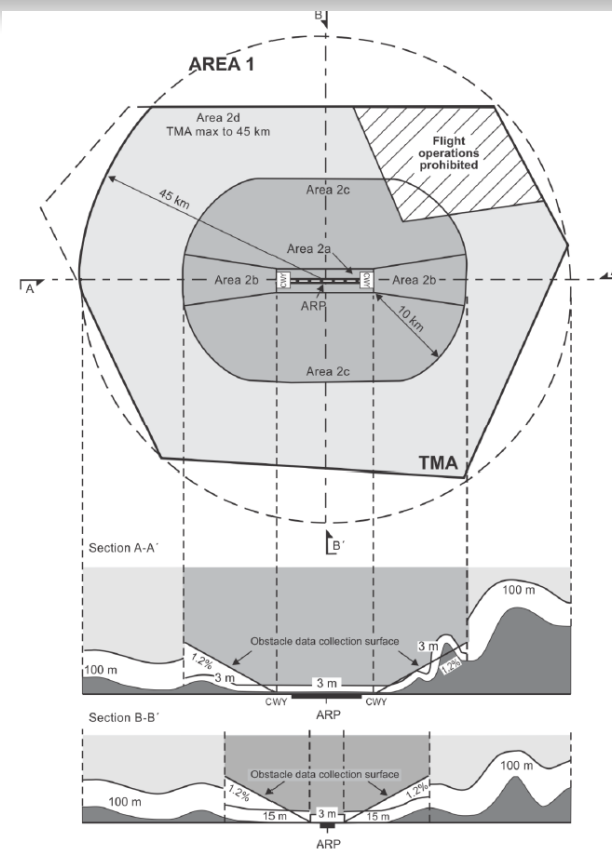
- In the area between 10 km and the TMA boundary or 45-km radius (whichever is smaller), data on terrain that does not penetrate the horizontal plane 120 m above the lowest runway elevation shall comply with the Area 1 numerical requirements.
- In those portions of Area 2 where flight operations are prohibited due to very high terrain or other local restrictions, terrain data shall comply with the Area 1 numerical requirements



Exceptions in Area 2 Data Specifications

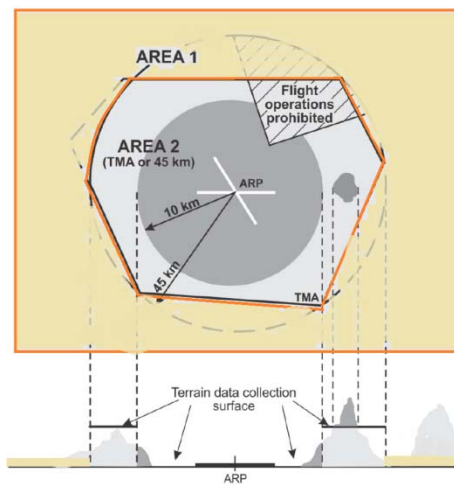
Obstacle data

- In those portions of Area 2 where flight operations are prohibited due to very high terrain or other local restrictions and/or regulations, obstacle data shall be collected and recorded in accordance with the Area 1 requirements

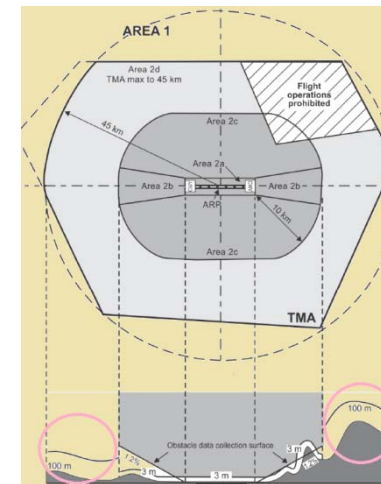


- **Coverage:** the entire territory of a State
- **Availability:**
 - Terrain data shall be provided for Area 1
 - Obstacle data shall be provided for obstacles in Area 1 whose height is 100m or higher above ground

Area 1 terrain



Area 1 obstacles





- Area 1 Terrain data specifications:

Post spacing	3 arc seconds (approx. 90 m)
Vertical accuracy	30 m
Vertical resolution	1 m
Horizontal accuracy	50 m
Confidence level	90%
Integrity classification	routine
Maintenance period	as required

- Area 1 Obstacle data specifications:

Vertical resolution (Pub.)	1 m (or 1 ft)
Horizontal resolution (Pub.)	1 sec
Vertical resolution (Chart)	3 m (or 10 ft)
Horizontal resolution (Chart)	As plotted
Vertical accuracy	30 m
Horizontal accuracy	50 m
Orig type	Surveyed
Integrity classification	routine



Obstacle attribute	Mandatory/Optional
Area of coverage	Mandatory
Data originator identifier	Mandatory
Data source identifier	Mandatory
Obstacle identifier	Mandatory
Horizontal accuracy	Mandatory
Horizontal confidence level	Mandatory
Horizontal position	Mandatory
Horizontal resolution	Mandatory
Horizontal extent	Mandatory
Horizontal reference system	Mandatory
Elevation	Mandatory
Height	Optional
Vertical accuracy	Mandatory
Vertical confidence level	Mandatory
Vertical resolution	Mandatory
Vertical reference system	Mandatory
Obstacle type	Mandatory
Geometry type	Mandatory
Integrity	Mandatory
Date and time stamp	Mandatory
Unit of measurement used	Mandatory
Operations	Optional
Effectivity	Optional
Lighting	Mandatory

- Obstacle data sets shall contain the digital representation of the vertical and horizontal extent of obstacles
- Obstacle data elements are features that shall be represented in the data sets by points, lines or polygons
- Obstacle data shall not be included in terrain data sets



Terrain attribute	Mandatory/Optional
Area of coverage	Mandatory
Data originator identifier	Mandatory
Data source identifier	Mandatory
Acquisition method	Mandatory
Post spacing	Mandatory
Horizontal reference system	Mandatory
Horizontal resolution	Mandatory
Horizontal accuracy	Mandatory
Horizontal confidence level	Mandatory
Horizontal position	Mandatory
Elevation	Mandatory
Elevation reference	Mandatory
Vertical reference system	Mandatory
Vertical resolution	Mandatory
Vertical accuracy	Mandatory
Vertical confidence level	Mandatory
Surface type	Optional
Recorded surface	Mandatory
Penetration level	Optional
Known variations	Optional
Integrity	Mandatory
Date and time stamp	Mandatory
Unit of measurement used	Mandatory

- Terrain data sets shall contain the digital representation of the terrain surface in the form of continuous elevation values at all intersections (points) of a defined grid, referenced to common datum
- A terrain grid shall be angular or linear and shall be of regular or irregular shape
- Sets of terrain data shall include spatial (position and elevation), thematic and temporal aspects for the surface of the Earth containing naturally occurring features such as mountains, hills, ridges, valleys, bodies of water, and permanent ice and snow, and exclude obstacles
- In terrain data sets, only one feature type, i.e. terrain, shall be provided



Subject	Property	Sub-Property	Type	Description	Note	Accuracy	Integrity	Orig Type	Pub. Res.	Chart Res.
Obstacle				All fixed (whether temporary or permanent) and mobile obstacles or parts thereof.						
	Obstacle identifier		Text	Unique identifier of obstacle						
	Operator / Owner		Text	Name and Contact information of obstacle operator or owner						
	Geometry type		Code list	An indication whether the obstacle is a point, line or polygon.						
	Horizontal position		Point Line Polygon	Horizontal position of obstacle		See Note 1)				
	Horizontal extent		Distance	Horizontal extent of the obstacle						
	Elevation		Elevation	Elevation of the highest point of the obstacle.		See Note 2)				
	Height		Height	Height of the obstacle above ground						
	Type		Text	Type of obstacle						
	Date and time stamp		Date	Date and time the obstacle was created						
	Operations		Text	Feature operations of mobile obstacles						
	Effectivity		Text	Effectivity of temporary types of obstacles						
	Lighting									
		Type	Text	Type of lighting						
		Colour	Text	Colour of the obstacle lighting						
	Marking		Text	Type of marking of obstacle						
	Material		Text	Predominant surface material of the obstacle						
			Note 1)	Obstacles in Area 1		50 m	routine	surveyed	1 sec	as plotted
				Obstacles in Area 2 (including 2a, 2b, 2c, 2d, take-off flight path area and obstacle limitation surfaces)		5 m	essential	surveyed	1/10 sec	1/10 sec
				Obstacles in Area 3		0.5 m	essential	surveyed	1/10 sec	1/10 sec
				Obstacles in Area 4		2.5 m	essential	surveyed		
			Note 2)	Obstacles in Area 1		30 m	routine	surveyed	1 m or 1 ft	3 m (10 ft)
				Obstacles in Area 2 (including 2a, 2b, 2c, 2d, take-off flight path area and obstacle limitation surfaces)		3 m	essential	surveyed	1 m or 1 ft	1 m or 1 ft
				Obstacles in Area 3		0.5 m	essential	surveyed	0.1 m or 0.1 ft/0.01 m	1m or 1 ft
				Obstacles in Area 4		1 m	essential	surveyed	0.1 m	



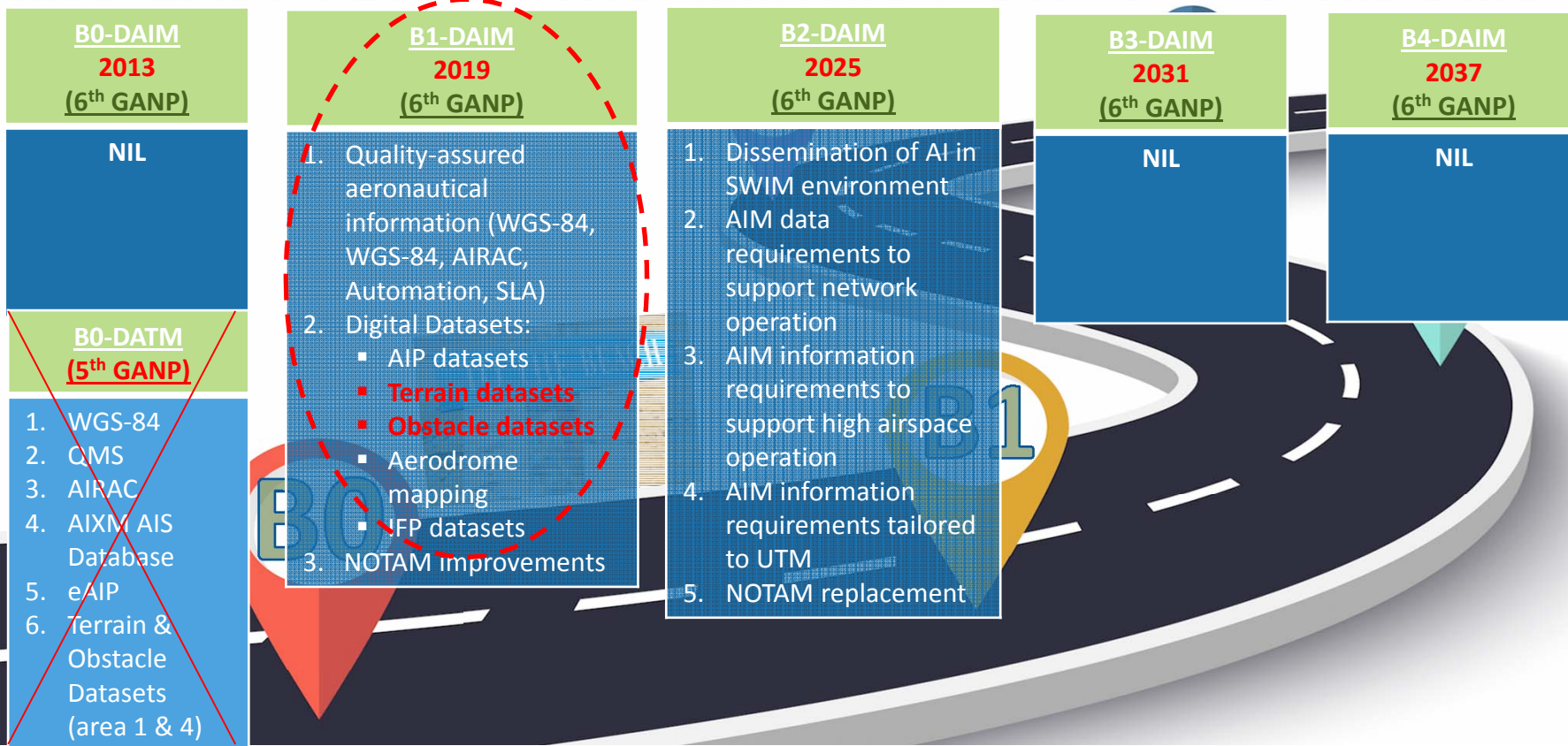
Terrain Data Specifications

Data Type		
Type (1)	Description (2)	Data elements (3)
Point	A pair of coordinates (latitude and longitude) referenced to the mathematical reference ellipsoid which define the position of the point on the surface of the Earth.	Latitude Longitude Horizontal reference system Units of measurement Horizontal accuracy achieved
Line	Sequence of Points defining a linear object	Sequence of Points
Polygon	Sequence of Points forming the boundary of the polygon. The first and last Point are identical.	Closed sequence of Points
Height	The vertical distance of a level, point or an object considered as a point, measured from a specific datum.	Numerical value Vertical reference system Units of measurement Vertical accuracy achieved
Altitude	The vertical distance of a level, a point or an object considered as a point, measured from mean sea level.	Numerical value Vertical reference system Units of measurement Vertical accuracy achieved
Elevation	The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.	Numerical value Vertical reference system Units of measurement Vertical accuracy
Distance	A linear value	Numerical value Units of measurement Accuracy achieved
Angle / Bearing	An angular value	Numerical value Units of measurement Accuracy achieved
Value	Any measured, declared or derived value not listed above.	Numerical Value Units of Measurement Accuracy achieved
Date	A calendar date referencing a particular day or month	Text
Schedule	A repetitive time period, composed of one or more intervals or special dates (e.g. holidays) occurring cyclically	Text
Code list	A set of predefined Text strings or values	Text
Text	Free text	String of characters without constraints

Data Specifications				
	Area 1	Area 2	Area 3	Area 4
Post spacing	3 arc seconds	1 arc second	0.6 arc seconds	0.3 arc seconds
	(approx. 90 m)	(approx. 30 m)	(approx. 20 m)	(approx. 9 m)
Vertical accuracy	30 m	3 m	0.5 m	1 m
Vertical resolution	1 m	0.1 m	0.01 m	0.1 m
Horizontal accuracy	50 m	5 m	0.5 m	2.5 m
Confidence level	90%	90%	90%	90%
Integrity classification	routine	essential	essential	essential
Maintenance period	as required	as required	as required	as required



TOD provisions in GANP





ICAO PARIS UNITING AVIATION



ICAO

North American
Central American
and Caribbean
(NACC) Office
Mexico City

South American
(SAM) Office
Lima

ICAO
Headquarters
Montréal

Western and
Central African
(WACAF) Office
Dakar

European and
North Atlantic
(EUR/NAT) Office
Paris

Middle East
(MID) Office
Cairo

Eastern and
Southern African
(ESAF) Office
Nairobi

Asia and Pacific
(APAC) Sub-office
Beijing

Asia and Pacific
(APAC) Office
Bangkok



THANK YOU

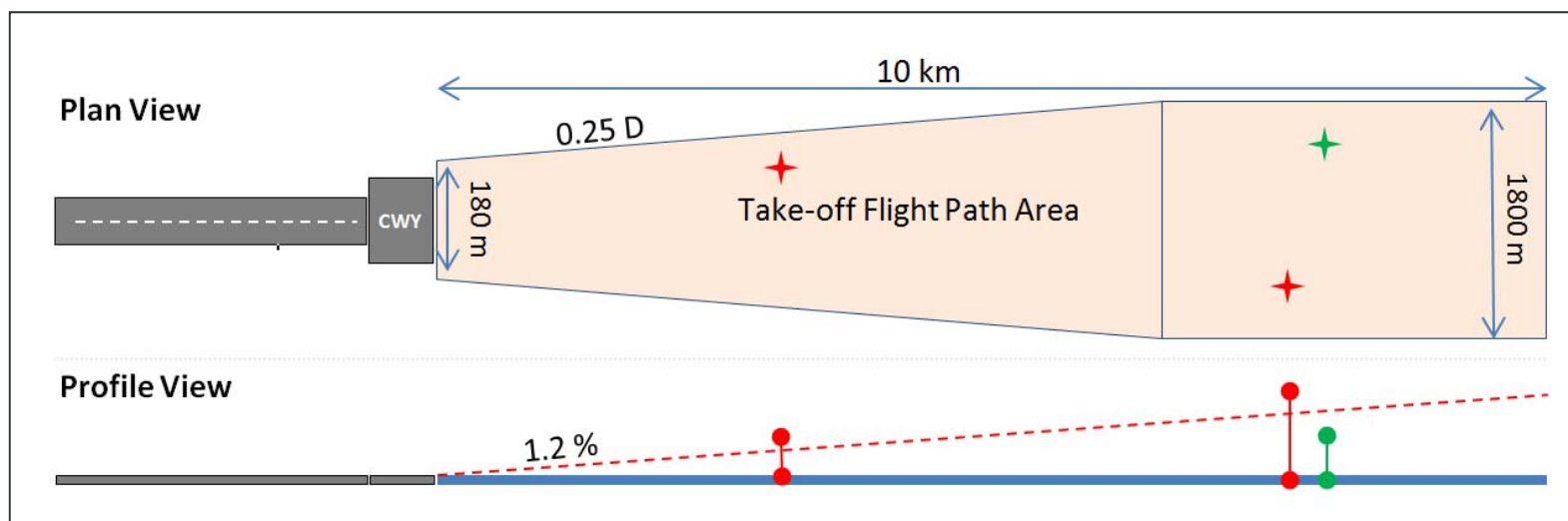


- **Post spacing.** Angular or linear distance between two adjacent elevation points (1 Second is approx. 30 m).
- **Data accuracy.** A degree of conformance between the estimated or measured value and the true value.
- **Data integrity (assurance level).** A degree of assurance that an aeronautical data and its value has not been lost or altered since the origination or authorized amendment.
- **Integrity classification (aeronautical data).** Classification based upon the potential risk resulting from the use of corrupted data. Aeronautical data is classified as:
 - a) **routine data:** there is a very low probability when using corrupted routine data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe;
 - b) **essential data:** there is a low probability when using corrupted essential data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe; and
 - c) **critical data:** there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe.
- **Data resolution.** A number of units or digits to which a measured or calculated value is expressed and used
- **Confidence level.** The probability that the true value of a parameter is within a certain interval around the estimate of its value.

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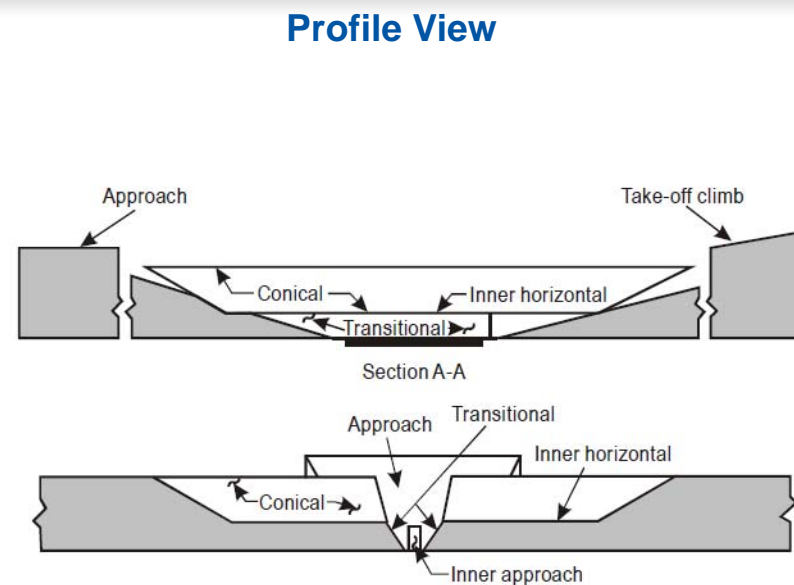
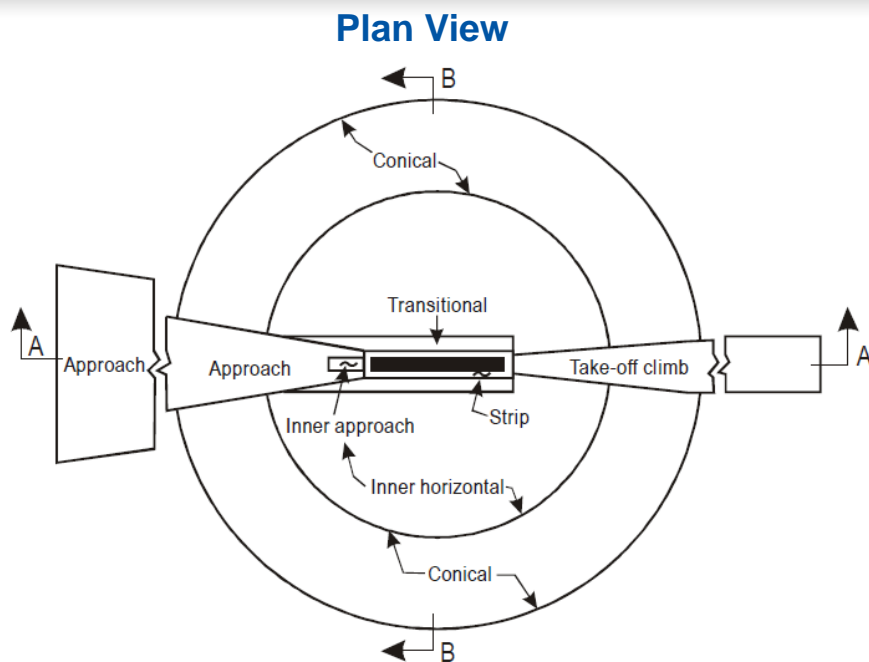
Take-off Flight Path Area



Ref.: Annex 4, Para. 3.8.2



Obstacle Limitation Surfaces



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Ref.: Annex 14, Volume 1, Chapter 4