Safety Regulation Group

Civil Aviation Authority

CAP 232

Aerodrome Survey Information

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31 January 2008

ISBN 978 0 11790 966 3

Edition 1, 1998
Edition 2, August 2000
Edition 3, March 2004
Edition 3, Amendment 1, 31 January 2008

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The latest version of this document is available in electronic format at www.caa.co.uk, where you may also register for e-mail notification of amendments.

Published by TSO (The Stationery Office) on behalf of the UK Civil Aviation Authority.

Printed copy available from:
TSO, PO Box 29, Norwich NR3 1GN www.tso.co.uk/bookshop
Telephone orders/General enquiries: 0870 600 5522 E-mail: book.orders@tso.co.uk

Amendment Record

Amendment Number	**Amendment Date**	**Incorporated by**	**Incorporated on**
01/2008	31 January 2008	CAA	31 January 2008

Amendment Number	Amendment Date	Incorporated by	Incorporated on

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Revision History

Edition 1 **1998**

CAP 232 was fundamentally revised in 1998 to reflect the adoption by ICAO of the World Geodetic System of 1984 (WGS-84). WGS-84 is the geodetic reference system for all aeronautical data.

Edition 2 **August 2002**

This edition contains no technical changes but reflects the change in publisher name from Westward Digital Limited to Documedia Solutions Limited.

Edition 3 **March 2004**

This edition contains no technical changes but reflects the change in publisher name from Documedia Solutions Limited to TSO (The Stationery Office).

Edition 3, Amendment 1 **January 2008**

In Chapter 8: Aerodrome Obstacle Chart – ICAO Type A Survey Area, the requirements have been revised to reflect the elimination of UK differences to ICAO Annex 4, Chapter 3: Aerodrome Obstacle Chart – ICAO Type A (Operating Limitations). Also, the CAA address details on the Inside Front Cover have been revised.

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Glossary of Terms

Above Mean Sea Level (AMSL)	Orthometric Height
Accelerate-Stop Distance Available (ASDA)	The length of the take-off run available plus the length of the stopway, if provided. (ICAO Annex 14)
Aerodrome Elevation	The elevation of the highest point of the landing area. (ICAO Annex 4)
Aerodrome Reference Point (ARP)	The designated geographical location of an aerodrome. (ICAO Annex 4)
AGA	Aerodromes, Air Routes and Ground Aids (ICAO Definition)
Cyclic Redundancy Check (CRC)	A mathematical algorithm applied to the digital expression of data that provides a level of assurance against loss or alteration of data. (ICAO Annex 14)
Ellipsoid Height	The height related to the reference ellipsoid, measured along the ellipsoidal outer normal through the point in question. (ICAO Annex 14)
Geoid	The equipotential surface in the gravity field of the Earth which coincides with the undisturbed mean sea level (MSL) extended continuously through the continents. (ICAO Annex 14)
Landing Area	That part of a movement area intended for the landing or take-off of aircraft. (ICAO Annex 4)
Landing Distance Available (LDA)	The length of landing distance available (ICAO Annex 14)
Obstacle	All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight. (ICAO Annex 14)
Orthometric Height	Height of a point related to the geoid, generally presented as a MSL elevation. (ICAO Annex 14)
Reference Ellipsoid	A geometric figure, usually determined by rotating an ellipse about its shorter (polar) axis, used as a surface of reference for geodetic surveys. The reference ellipsoid closely approximates to the dimensions of the geoid, with certain ellipsoids fitting the geoid more closely for various areas of the earth.(Non ICAO)
Survey Date	The date that fieldwork was carried out to obtain data for the survey. Where fieldwork was completed over more than one day the end date of fieldwork shall be used.

Take-off Distance Available (TODA)	The length of the take-off run available plus the length of the clearway if provided. (ICAO Annex 14)
Take off Run Available (TORA)	The length of the take-off run available (ICAO Annex 14)
Threshold	The beginning of that portion of the runway usable for landing. (ICAO Annex 4)

Chapter 1 Introduction

1 Preamble

CAP 232 details the survey requirements and presentation required by the Civil Aviation Authority (CAA) to ensure Aerodrome Licensees comply with their legal responsibilities under Article 102 (as amended), Schedule 14, Air Navigation Order (ANO).

2 Purpose

2.1 The purpose of aerodrome survey information is to enable Aerodrome Licensees to meet their safety responsibilities and provide the data required by the CAA to enable it to:

- consider aerodrome licensing issues;
- design and develop operational flight procedures;
- prepare charts; and
- conduct safety evaluations.

2.2 Following these processes, selected information shall be published in the Aeronautical Information Publication (AIP) and other associated documents.

3 Survey Philosophy

3.1 The basic survey philosophy applied in this publication is to provide master lists of all aerodrome facilities (i.e. runways, navigation aids, etc.) and features identified as obstacles for each Aerodrome constrained by the appropriate area of interest. These lists form the basis for all charting, obstacle filtering (using obstacle identification surfaces) and analysis for Instrument Flight Procedures (IFP) design.

3.2 The challenge placed upon surveying companies is to identify appropriate features to survey in creating these "Master lists". It will be totally impracticable and costly to survey all features. Therefore it is important for surveying companies to understand the tasks and challenges faced by the end user, i.e. CAA Aeronautical Charts and Data (ACD), IFP designers, Aerodrome Inspectors and Aerodrome Licensee (with regard to Safeguarding), in achieving their individual objectives. From an IFP design perspective the appropriate surveyed area and "real world" obstacle representation ("Master Obstacle list") forms the critical baseline for successful IFP design.

4 Publication Structure

This publication is structured to assist the following logical steps:

a) Choosing the relevant aerodrome survey classification.

b) Determining the areas to be surveyed.

c) Surveying the areas required.

d) Populating Aerodrome Facilities and Master Obstacle data lists.

e) Producing plans and filtering obstacle data as required.

f) Producing a survey report.

g) Distributing relevant data and information.

5 Mandatory Requirements

5.1 This publication strives to minimise the cost to Aerodromes while providing the minimum prescribed safety standards and requirements. The CAA fully recognises that each individual Aerodrome governs its own operational needs and therefore the level of survey required should be appropriate and economical to the type of operation intended for its purpose.

5.2 Aerodrome Licensees shall provide accurate survey information of their aerodrome and environs according to the type of operation identified by aerodrome survey classification and survey areas required as prescribed in Table 1 and shall be carried out to measure any changes at the periodic intervals as set out in Table 2.

6 Survey Areas

The Survey Areas required for a particular Aerodrome Survey Classification are prescribed in Table 1.

Table 1 Aerodrome Survey Classification and Survey Areas Required

Type of Operation	**Aerodrome Survey Classification**
Aerodrome with no Instrument Flight Procedures (IFP)	1
Aerodrome with Non-precision IFP	2
Aerodrome with Precision ILS CAT I or equivalent IFP	3
Aerodrome with Precision ILS CAT II/III or equivalent IFP	4

Survey Area	**Reference**	**Aerodrome Classification**			
		1	**2**	**3**	**4**
Aerodrome Plan	Chapter 5	☑	☑	☑	☑
AGA	Chapter 6	☑	☑	☑	☑
Non-precision Instrument Approach (*)	Chapter 7	☒	☑	☑	☑
Visual Manoeuvring (Circling)	Chapter 7	☒	☑	☑	☑
Departure (#)	Chapter 7	☒	☑	☑	☑
Aerodrome Obstacle Chart - Type A (~)	Chapter 8	☒	☑	☑	☑
Precision Approach Procedure	Chapter 9	☒	☒	☑	☑
Precision Approach Terrain Chart	Chapter 10	☒	☒	☒	☑

(*) Only required for aerodrome classification 3 and 4 if runways have additional Non-precision IFP.

(#) Only applicable to runways from which IFR departures take place.

(~) Only required if runways used by Performance A aeroplanes engaged in Public Transport flights.

7 Survey Periodicity

Surveys shall be undertaken for all Survey Areas required to measure any changes at the periodic intervals prescribed in Table 2.

Table 2 Survey Periodicity

Survey Type	Aerodrome Classification	Periodicity
Geodetic Connection	2, 3 and 4	1. Together with an initial full survey. 2. When a more accurate reference frame for WGS-84 becomes available.
Full Survey	1, 2, 3 and 4	1. Initial survey. 2. If a check survey is not carried out annually. 3. If any doubt exists as to the validity of a previous survey.
Check Survey	1, 2, 3 and 4	1. Annually after a full survey.

8 Survey Procedures

8.1 Geodetic Connection

- The procedures for a geodetic connection are detailed in Chapter 2.
- The geodetic connection date shall be included with the submission of a Survey Declaration Form (see Annex A).

8.2 Full Survey

- The procedures for a full survey are detailed in Chapter 2.
- All full surveys shall be notified by the submission of a Survey Declaration Form (see Annex A).

8.3 Check Survey

- The annual check survey is to identify any changes, including significant tree growth or reduction, since the previous survey. Any change shall be surveyed to the specifications detailed in this publication.
- All check surveys shall be notified by the submission of a Survey Declaration Form (see Annex A)

9 Data Management

9.1 Proper data management is crucial during the entire survey and subsequent declaration process. Survey companies are urged to implement rigorous data handling processes and practices to eliminate erroneous data submission. Each surveyed entity and associated attributes shall be dealt with as a single data record

stream. Any change to an existing data record stream identified during a subsequent annual check survey shall necessitate a re-issue of the entire data record with a new unique record number and the deletion of the old record number.

For example: If a check survey is carried out on an existing mast (e.g. data record number 1023) and is found to be higher or lower than previously declared, data record 1023 will be deleted in toto and a new data record declared together with a new unique data record number (e.g. 2056). The surveyor shall declare the deleted and new record and the reason(s) for change. The old record shall be deleted irrespective if the new record is the same mast located at the same position.

9.2 If no changes were found to all attributes in an existing record the record shall retain its original record number and survey date.

9.3 If a later full survey is submitted following an initial full survey, all previous data records shall be declared as obsolete and a new list of survey data records shall be declared with new record numbers and new survey dates.

10 Survey Declaration Form

10.1 A "Survey Declaration Form" (see Annex A) shall accompany all full and check survey submissions. Completion of this Form confirms that the survey information submitted to the Civil Aviation Authority meets the requirements and accuracies detailed in this publication. The Aerodrome Licensee should state the survey areas appropriate to their operational requirements and the type of survey undertaken, i.e. full or annual check survey. The surveyor is required to state the change or no change status for each survey area.

10.2 **Failure to submit an annual check Survey Declaration Form may result in the withdrawal of the relevant published chart.**

11 Qualifying Surveying Companies.

11.1 The Aerodrome Licensee shall satisfy itself as to the competence of the surveyors it employs for aerodrome surveys. The following is a list of characteristics that should be considered:

- Accredited to an ISO 9001:2000 standard or operate an equivalent quality control system.
- Professionally qualified surveyors and project managers to oversee the survey.
- Field survey staff competent in aerodrome surveying techniques and experienced at working in an operational aerodrome environment.
- Professional indemnity cover.

11.2 All surveying companies employed in survey work for aerodromes with IFPs should be registered with the CAA. Registration ensures that surveyors are informed of changes to policy or procedures and is NOT a select list of approved companies. Applicants should apply in writing, giving relevant credentials, to:

- Manager Aeronautical Charts and Data, Directorate of Airspace Policy, Civil Aviation Authority, CAA House, 45-59 Kingsway, London WC2B 6TE.

12 Accuracy

Appropriate survey methods shall be applied to qualify the accuracy and integrity of the data provided. Survey methodology shall be clearly demonstrated in the Survey Report. Requirements are stated in ICAO DOC 9674-AN/946 (WGS-84 Manual) and the most stringent survey accuracy shall apply for Aerodrome Classification 2, 3 and 4 as prescribed in Table 3.

Table 3 Minimum Survey Accuracy and Integrity Requirements

	Horizontal Accuracy	**Vertical Accuracy**	**Integrity Classification**
Aerodrome Control Network	1.0 m (*)	1.0 m (*)	1×10^{-8}
Aerodrome Facilities	0.5 m (#)	0.25 m (#)	1×10^{-8}
Obstacles and Off Aerodrome Facilities	3.0 m (#)	0.3 m (#)	1×10^{-5}
(*) Accuracy with respect to the appropriate geodetic reference frame (#) Accuracy relative to the aerodrome control network			

13 Survey Package

13.1 The completed survey package for submission to the Authority shall consist of the following:

- Two electronic copies on CD-ROM to include the Survey Report and Survey Plans in Adobe PDF* format and accompanying Digital Data in Annex B format.
- One original signed copy of completed Survey Declaration Form.

(* For acceptability of other formats refer to paragraph 16)

13.2 For Aerodrome Classification 1 the survey package, comprising report, plans, data and declaration form may be submitted in hard copy format.

13.3 The Aerodrome Licensee is responsible for ensuring that copies of all survey information and Survey Declaration Form are forwarded within 60 days of the survey date to:

ACD, DAP, Civil Aviation Authority, CAA House, 45-59 Kingsway, London WC2B 6TE

13.4 Surveys that fail to conform to the requirements stated in this publication will be rejected and returned to the Aerodrome Licensee.

13.5 Ownership and copyright of survey data resides with the Aerodrome Licensee. However, to aid the Defence Geographic Centre (DGC) in preparation of topographical charts, which has a general aviation safety benefit, Aerodrome Licensees are requested to inform the Authority if they do not agree to the release of their survey data to DGC.

14 Conversion Factors

ICAO Annex 5 is used as the standard for the application of all conversion factors.

Non-SI Units	SI Units
1 Nautical Mile (nm)	1.852 kilometres (km)
0.54 nm	1 km
1 Foot (ft)	0.3048 metres (m)
3.2808 ft	1 m
1nm = 6076.04 ft	

15 Standard Documents

- ICAO DOC 9674-AN/946 (WGS-84 Manual)
- ICAO Annex 4 (Aeronautical Charts)
- ICAO Annex 5 (Units of Measurement to be Used in Air and Ground Operations)
- ICAO Annex 14 (Aerodromes)
- ICAO Annex 15 (Aeronautical Information Services)
- ICAO DOC 8168 - OPS/611(PANS OPS)
- Air Navigation: the Order and the Regulations CAP 393
- Licensing of Aerodromes CAP 168
- Safeguarding of Aerodromes CAP 738

- EUROCONTROL Doc CHAIN/0028 (Integrity of Aeronautical Information Principles – Data and Quality Management)

16 Guidance and Policy

For guidance and policy on points that are not covered within this publication advice should be sought from DAP, CAA House, 45-59 Kingsway, London WC2B 6TE.

Chapter 2 Survey Procedure

1 General

1.1 The accuracy and integrity requirements for the geodetic connection and surveyed data are stated in Table 3.

1.2 Surveyed data that does not meet the accuracy and integrity requirements is unacceptable for IFP design and will be published in the AIP with an asterisk. Aerodromes without Instrument Flight Procedures do NOT need to undertake surveys to the accuracy and quality assurance requirements stated in the ICAO DOC 9674-AN/946 (WGS-84 Manual). The Aerodrome Licensee is responsible for ensuring the accuracy of information required for Aerodrome Plan and AGA survey areas. It is recommended that a surveyor or suitably experienced person provide the plans and data.

2 Horizontal Control

2.1 Co-ordinates will be required in WGS-84 format (required format for published data) and appropriate National Grid (for plotting and design on topographical charts).

2.2 Survey control points shall conform to the ICAO DOC 9674-AN/946 (WGS-84 Manual).

2.3 WGS-84 geodetic control and format requires that the methods deployed must prove that the accuracy for the various surveys has been met. Survey companies undertaking these surveys shall be responsible for the accuracy of the control data and any transformation sets used. An analysis of the accumulated error, evidence confirming the required accuracies have been met and the transformation parameters used shall be included in the Survey Report.

3 Vertical Control

3.1 Orthometric and ellipsoidal elevations are required.

3.2 The variable separation between the geoid and the reference ellipsoid may give rise to inaccuracies greater than the allowable specified. For the computation to transform ellipsoidal to orthometric elevations a geoid model should be used. If a geoid model is not available extra care must be taken to ensure good geometry of the initial control points. In all cases appropriate survey checks shall be applied to prove the quality of vertical control. These checks shall be included within the survey report.

3.3 Standard survey practice shall be used to produce the elevation to the required specification accuracy and the integrity of the control points used shall be proved.

4 Instrumentation

All survey equipment shall have a current calibration certificate and be able to perform to the accuracy appropriate to the requirements of the surveys.

5 Methodology

5.1 All permanent controls that are established within the aerodrome boundary shall be documented and traceable.

5.2 Office appreciation using contour maps can aid in the process of defining the probable extent of the survey and the likely position of obstacles. Local scale factor adjustment to ground distances shall be considered, and the effects of curvature and refraction.

5.3 New obstacle data shall be proved by two independent measurements and their resultant elevations and positions shall satisfy the appropriate survey criteria.

5.4 Obstacles heighted on previous surveys need only to be checked to confirm their height and position without the rigour afforded to new obstacles. Particular attention should be paid to structures and trees whose height may change. An appreciation of the effects of vertical angles over variable distances is necessary to give good height accuracies. It is recommended that observations taken without corrections for curvature and refraction should be limited to a maximum of 1 km.

6 Obstacles to be Heighted

6.1 Surveying companies should take note that when surveying a prescribed area, a situation might arise where the highest obstacle within that area might not necessarily be the dominant obstacle for that particular phase of flight. Therefore, surveyors should always declare an obstacle in the Master Obstacle list if any doubt exists to its validity as an obstacle.

6.2 Obstacles include terrain, vegetation and structures.

6.3 Where there are a large number of obstacles to be heighted it will be impractical to survey, for example, every tree in a wooded area and therefore the surveyor should consult with the Aerodrome Licensee and the Instrument Flight Procedure (IFP) designers where necessary.

6.4 Due consideration must be taken when observing transverse and longitudinal obstacles in close proximity to the runway because their leading edge may have greater significance than the highest point. (It must be appreciated that the highest object might not be the most important for consideration, see Figure 1.)

6.5 Fine obstacles such as lightning conductors or aerials that surmount the object may not be visible over a distance. Therefore care must be taken when observing distant obstacles to ensure that the highest point is heighted.

6.6 Temporary obstacles encountered at the time of survey should be included and identified as temporary. A statement should be included in the Survey Report stating the temporal extent of all such obstacles.

6.7 When submitting the report, the surveyor should include details of all obstacles surveyed, whether they penetrate the relevant surfaces or not.

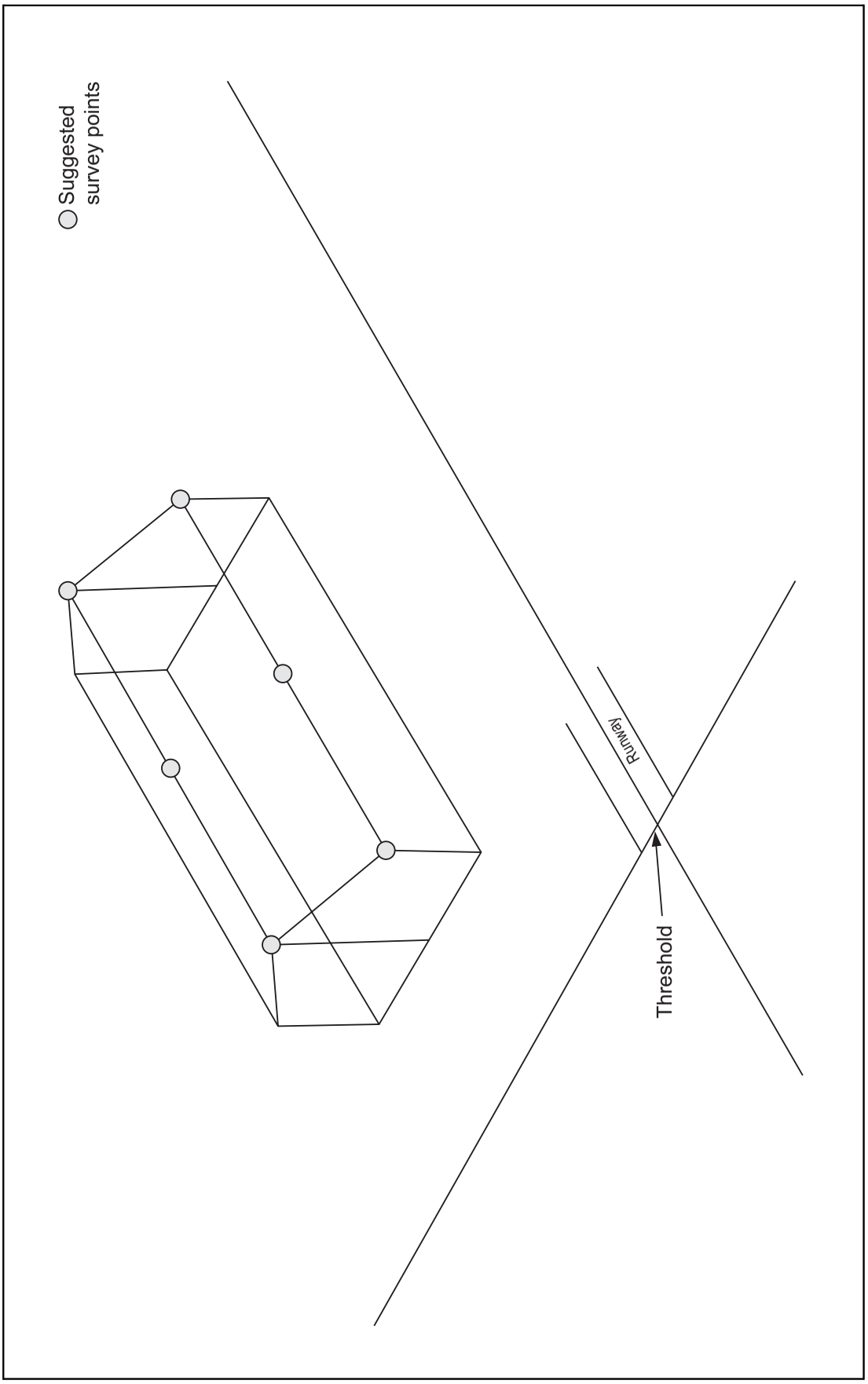

Figure 1 Transverse and Longitudinal Obstacles

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Chapter 3 Presentation

1 Plans

1.1 The format of the base mapping for the Aerodrome Plan is at the discretion of the Aerodrome Licensee. Listed below are the formats accepted by CAA:

- Digital mapping (see Chapter 1, paragraph 13).
- Hard copy mapping compilations.
- Published mapping sheets.
- or approved equivalent.

1.2 Surveyors shall ensure the following:

- The most recent mapping shall be used.
- National Grid reference system shall be shown with grid values along the plan edge at convenient intervals.
- Data reference source and revision data shall be shown on the plan.
- Copyright licence requirements shall be met when required.

1.3 **Plan Sheet Size**

It is recommended that the sheet size should be limited to A0 size for easy storage and handling. Where this is not practical due to the extent of the survey area, out-size and adjoining sheets may be used. When using an adjoining sheet system, it should be capable of being abutted and orientated to give the most economical coverage.

1.4 **Plan Sheet Layout**

1.4.1 Where multi-sheets are used, full reference shall be given to the total number in the series.

1.4.2 Each sheet shall have a title panel. The information shown should consist of the following:

- Aerodrome
- Drawing Title
- Drawing number or reference number including current amendment status.
- Date of survey
- Scale
- Survey company name and address including telephone number
- Surveyed by
- Checked by
- Sheet number
- Sheet lay-out and diagram, if applicable
- Abbreviations used
- A reference to the appropriate survey report
- Statement of vested copyright

2 Survey Reports

2.1 Geodetic Connection Report (if required)

Shall include the following:

- Quality Records as per Chapter 4, paragraph 1
- Details of the connection of the aerodrome control network to the geodetic network
- Aerodrome control network plan
- Survey stations descriptions
- Transformation parameters

2.2 Full Survey Report

Shall include the following:

- Quality Records as per Chapter 4, paragraph 1
- Survey Declaration Form - Annex A

2.3 Check Survey Report

Shall include the following:

- Abbreviated Quality Records that refer back to the previous Full Survey with regard to surveying methodology
- Survey Declaration Form - Annex A
- Schedules listing all obstacles that have been added or deleted since the last survey (see Chapter 3, paragraph 2.5)

2.4 For traceability purposes the complete documentation shall be reissued on every occasion that a check survey amends the preceding full or check survey.

2.5 Format of the schedules listing changes shall be at the discretion of the surveyor or as agreed with the Aerodrome Licensee. It is recommended that schedules are prepared as digital spreadsheets. To enable users to track changes where an obstacle has been given a new feature number the old number shall be referenced against it.

3 Digital Data

3.1 The following master files of all surveyed obstacles and aerodrome facilities shall be created and supplied in Annex B format:

a) Master obstacles file, named appropriately, e.g. egxx_obst00.crc ("egxx" is the ICAO indicator code for the surveyed aerodrome and "00" is the year of the survey). To include:

- All features identified as obstacles.

b) Aerodrome facilities file, named appropriately, e.g. egxx_ad00.crc ("egxx" is the ICAO indicator code for the surveyed aerodrome and "00" is the year of the survey). To include:

- All facilities surveyed for the purposes of the Aerodrome Plan survey area.

3.2 The integrity of the survey information supplied in digital format (see Annex B) shall be protected against third party corruption by wrapping with a Cyclic Redundancy Check (CRC). A 32 bit CRC-32Q algorithm value (CRCV format = Hexadecimal) is provided by Eurocontrol DQTS CRC Tool, for further information contact ACD, DAP, CAA. CRC wrapping is mandatory for all survey data Annex B format files.

Chapter 4 Quality Assurance

1 Quality Records

1.1 All data elements for aerodromes with Instrument Flight Procedures shall be traceable to their source of production by an unbroken audit trail. The surveying company, following guidance given in the WGS-84 Quality Assurance Manual, shall provide information on the source of production in the form of Quality Records.

1.2 Quality Records shall include:

- Surveying organisation
- Name of surveyor(s)
- Date and purpose of survey
- Method of survey and equipment used
- Equipment calibration information and method of checking the survey
- Evidence that the accuracy requirements have been met including details of the error budget analysis.

2 Methodology

The surveying company shall maintain an effective checking system to ensure that the data collected conforms to the accuracy standard and shall present proof of that conformity within the Survey Report.

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Chapter 5 Aerodrome Plan Survey Area

1 Purpose

The Aerodrome Plan is part of the Aerodrome Manual which licensees are required to maintain for licensing and safeguarding purposes. The Aerodrome Plan is a working document that gives an accurate picture of the aerodrome configuration and integral facilities.

2 Survey Specification

2.1 The survey specification for the Aerodrome Plan is covered in ICAO DOC 9674 - AN/946 1st Edition 1997(WGS 84 Manual). Licensees of Aerodromes without Instrument Flight Procedures see Chapter 2, paragraph 1.

2.2 All features listed at Chapter 5, paragraph 3.5 shall be surveyed.

3 Plan Content

3.1 The scale shall be 1:2500. The accepted format of the plan is covered in Chapter 3 paragraph 1.1.

3.2 The area of the plan shall show the limits of the aerodrome boundary and the locations of installations that are considered integral to the operational procedures of the aerodrome. Insets may be required to show off-site facilities.

3.3 All aerodrome characteristics as described in CAP 168 (Licensing of Aerodromes) and relevant buildings shall be shown on the plan. Surveyed features shall be represented by an appropriate symbol and labelled by survey identification number. The operational runway(s) shall be shown by a solid line, the runway markings and approach lighting arrays shall be shown true to scale.

3.4 The height above local ground level (AGL) and elevation AMSL to the highest point of the feature in metres and feet are required for all features surveyed that are greater than 0.9m above local ground level within the runway strip.

3.5 WGS 84 and OSGB36 co-ordinates and orthometric elevation AMSL and height AGL (where applicable) shall be shown on the plan for the following features.

- Aerodrome Beacon (Identification or Location)
- Aerodrome Elevation
- Aircraft stand points
- Anemometer(s)
- ARP
- ATC tower
- DME
- End of ASDA
- End of LDA
- End of TODA

- End of TORA
- ILS Localizer and Glidepath antennae
- ILS Middle and Outer Markers (where applicable show as inset on plan)
- IRVR
- MLS Azimuth and Elevation antennae
- NDB(Locator)
- PAPI/APAPI
- Radar antenna
- Runway Observing Position (ROP)
- Runway centre-line elevation points
- Runway edge lights if human observed RVR is in use

- Start of TORA
- Taxi-Holding positions
- Thresholds
- TLOF
- UHF and VHF transmitters
- VDF
- VOR
- Windsleeve(s)

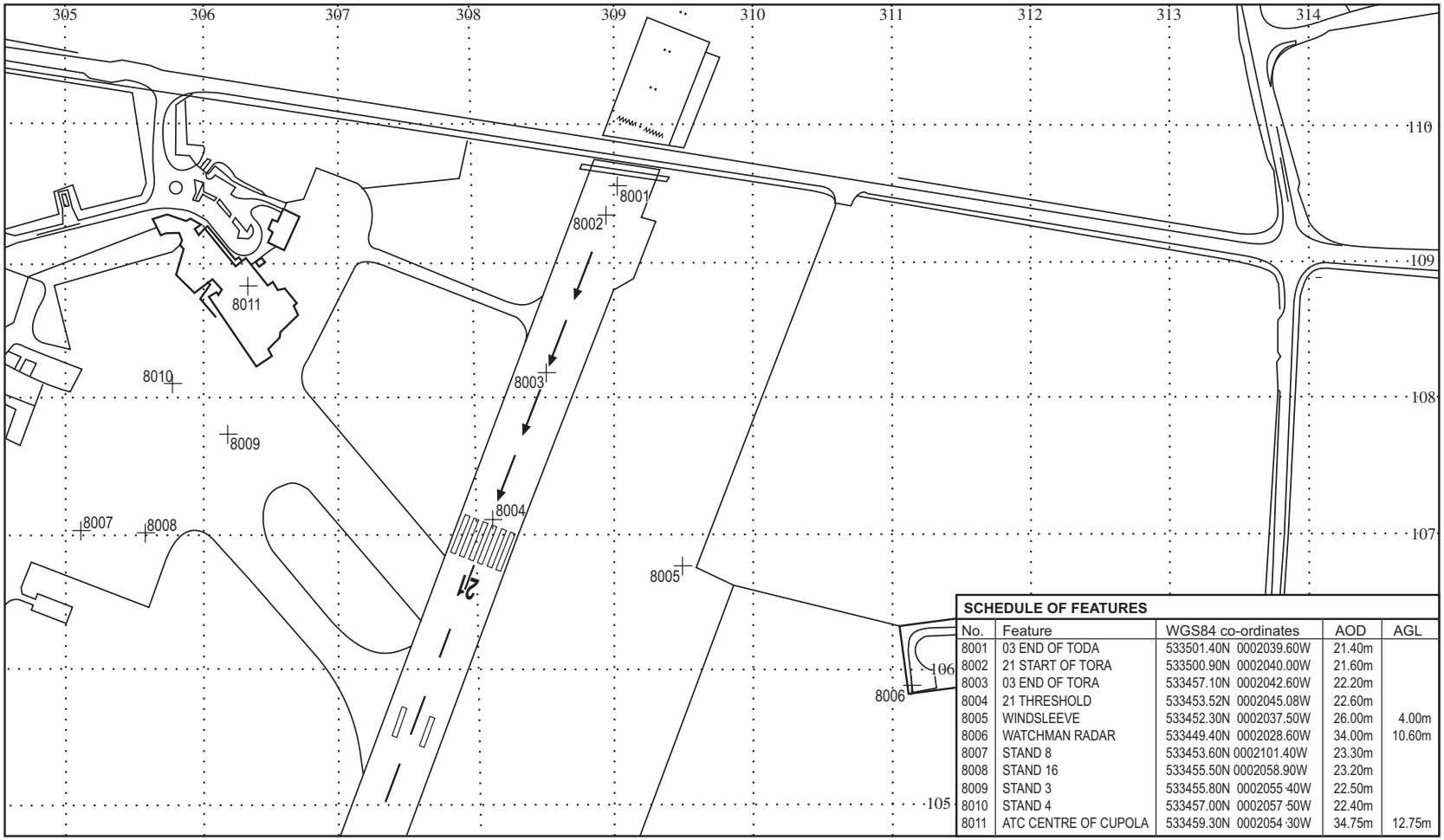
3.6 The co-ordinates and associated data shall be in a schedule format within the margin of the plan (see Figure 2).

3.7 Additional information may be required; this shall be at the request of the Aerodrome Licensee and may include the following:

- Fire service accommodation
- Emergency access/egress gates and routes
- Emergency water supply tanks
- Facility safeguarding (fences)
- ROP to runway edge lights distances (see CAP 168 for guidance)
- Human Observed RVR Conversion Table (see CAP 746 for specimen)

4 Digital Data

All surveyed features shall form part of the 'Aerodrome Facilities listing' depicted in Annex B.



SCHEDULE OF FEATURES

No.	Feature	WGS84 co-ordinates	AOD	AGL
8001	03 END OF TODA	533501.40N 0002039.60W	21.40m	
8002	21 START OF TORA	533500.90N 0002040.00W	21.60m	
8003	03 END OF TORA	533457.10N 0002042.60W	22.20m	
8004	21 THRESHOLD	533453.52N 0002045.08W	22.60m	
8005	WINDSLEEVE	533452.30N 0002037.50W	26.00m	4.00m
8006	WATCHMAN RADAR	533449.40N 0002028.60W	34.00m	10.60m
8007	STAND 8	533453.60N 0002101.40W	23.30m	
8008	STAND 16	533455.50N 0002058.90W	23.20m	
8009	STAND 3	533455.80N 0002055·40W	22.50m	
8010	STAND 4	533457.00N 0002057·50W	22.40m	
8011	ATC CENTRE OF CUPOLA	533459.30N 0002054·30W	34.75m	12.75m

Figure 2 Extract of Part of an Aerodrome Plan

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Chapter 6 AGA Survey Area

1 Purpose

1.1 The purpose of the AGA survey is to identify all obstacles that infringe the prescribed AGA obstacle limitation surfaces appropriate to the existing or proposed runway coding.

1.2 The survey data enables the Aerodrome Licensee to make safety evaluations and assists the CAA to make assessments for the grant, retention or modification of an Aerodrome Licence.

1.3 It is the Aerodrome Licensees' responsibility to promulgate selected significant obstacles within the AGA approach, take-off climb and circling areas in the Aeronautical Information Publication (AIP). To aid this selection it is recommended that Licensees ensure the surveyor provides a list of obstacles that infringe the surfaces, including extent of infringement. For guidance, identify and report the following:

- First obstacles in the Take-Off Climb Surfaces
- Lines of trees/pylons close to the aerodrome in the Approach/Take-Off Climb Surfaces
- High ground that may affect the circuit height
- Obstacles (chimney, mast, etc.) within the circling area that are significantly higher than the aerodrome elevation.
- Lit aerodrome features or large single objects that may not necessarily be infringements.

2 Survey Specification

2.1 **The AGA obstacle limitation surfaces are listed below:**

- 1:10 surface from the runway centreline*
- Runway Strip*
- Clearway (when applicable) *
- Transitional Surface*
- Take-Off Climb Surface*
- Approach Surface*
- Inner Horizontal Surface*
- Conical Surface*
- Outer Horizontal Surface
- Obstacle Free Zone Surface, comprising the inner approach, inner transitional and landing surfaces (precision approach only).

2.2 Aerodrome Licensees of airfields that have visual runways only without Instrument Flight Procedures (IFP) may limit their survey to the asterisked items at Chapter 6, 2.1, within the remit of abbreviated requirements given at Chapter 2, paragraph 1.

2.3 The Aerodrome Licensee before the start of work will give the origin of each surface, relative to a particular runway, to the surveyor.

2.4 The dimensions and slopes of the various surfaces are defined and illustrated in CAP 168.

2.5 The survey requirement is to height all obstacles within the AGA obstacle limitation surfaces area that infringe the limitation surfaces.

2.6 Special care must be exercised in the near environs of the approach and take-off climb area to ensure complete obstacle coverage.

3 Digital Data

All surveyed obstacles shall form part of the "Master Obstacles listing" depicted in Annex B.

Chapter 7 Dominant Obstacle Survey Areas

1 Purpose

The purpose is to provide obstacle information for the applications listed below:

- Non-Precision Instrument Approach Procedures as follows:

  Surveillance Radar - termination range 0.5, 1 and 2 nautical miles
  NDB (Non-directional Radio Beacon)
  VOR (VHF Omni directional Radio Range)
  ILS Localiser / MLS Azimuth only

- Visual Manoeuvring (Circling) Areas.
- Departure Areas 1 and 2.

2 Survey Specification

2.1 Non-Precision Instrument Approach Area

2.1.1 The survey area is divided into a mosaic of tiles as illustrated in Figure 3. The optimum tile size is 0.5 km x 1 km. However, the Aerodrome Licensee may select a tile dimension larger than the optimum after consultation with TA, DAP. The total area has been designed to allow the IFP designer the flexibility to adjust the approach and missed-approach path to gain the best operational advantage in terms of OCH with regard to the local terrain and/or airspace restrictions, against the design criteria laid down in PANSOPS Vol II.

2.1.2 The optimum requirement is to height the three highest obstacles in each tile, thus allowing the IFP designer to calculate the most advantageous Minimum Descent Altitude/Height (MDA/H). However, in analysing the three highest obstacles in any one tile, consideration must be given to other obstacles within the same tile where such additional obstacles are located closer to the nominal flight path of an aircraft approaching or departing an aerodrome. For example, if there were three chimneys adjacent to each other near the outer edge of the tile furthest from the nominal flight path and there was an office building located within the same tile closer to the nominal flight path but marginally lower than the three chimneys, then all four obstacles should be declared. Situations may exist where more than three, four or five obstacles are declared within any one tile.

2.1.3 If it is apparent that there are significant obstacles beyond the 10 km limit, the survey area shall be extended longitudinally to 30 km to take account of such obstacles. A significant obstacle is one that is not shielded by an obstacle closer to the runway as illustrated in Figure 3.

2.2 Visual Manoeuvring (Circling) Areas

2.2.1 Applicable only at aerodromes with Instrument Flight Procedures.

2.2.2 The number of runways in use and the Approach Category of aircraft using the aerodrome shall determine the VM areas.

2.2.3 The survey areas for consideration are constructed by describing arcs of the appropriate radius as detailed below, centred on the thresholds, and joined by common tangents to form an enclosed area (see Figure 4).

- Category A aircraft: 3.12 Kilometres (1.68 Nautical Miles)
- Category B aircraft: 4.90 Kilometres (2.66 Nautical Miles)
- Category C aircraft: 7.85 Kilometres (4.20 Nautical Miles)
- Category D aircraft: 9.79 Kilometres (5.28 Nautical Miles)
- Category E aircraft: 12.82 Kilometres (6.94 Nautical Miles)

2.2.4 The Aerodrome Licensee shall advise on circling Category requirements.

2.2.5 The survey requirement is to height the three highest obstacles in each segment defined by the extended runway centre lines and aircraft category boundaries (see Figures 4 and 5), thus allowing the IFP designer to calculate the most advantageous minimum OCA/H.

2.3 **Departure Areas**

2.3.1 Applicable to runways from which IFR departures take place.

2.3.2 The Departure survey area is illustrated in Figure 6. NOTE: Area 2 may vary according to Departure Procedure Design requirements.

2.3.3 The survey requirement is to height all obstacles in this area that penetrates the 1:40 slope.

3 Digital Data

All surveyed obstacles shall form part of the "Master Obstacles listing" shown in Annex B

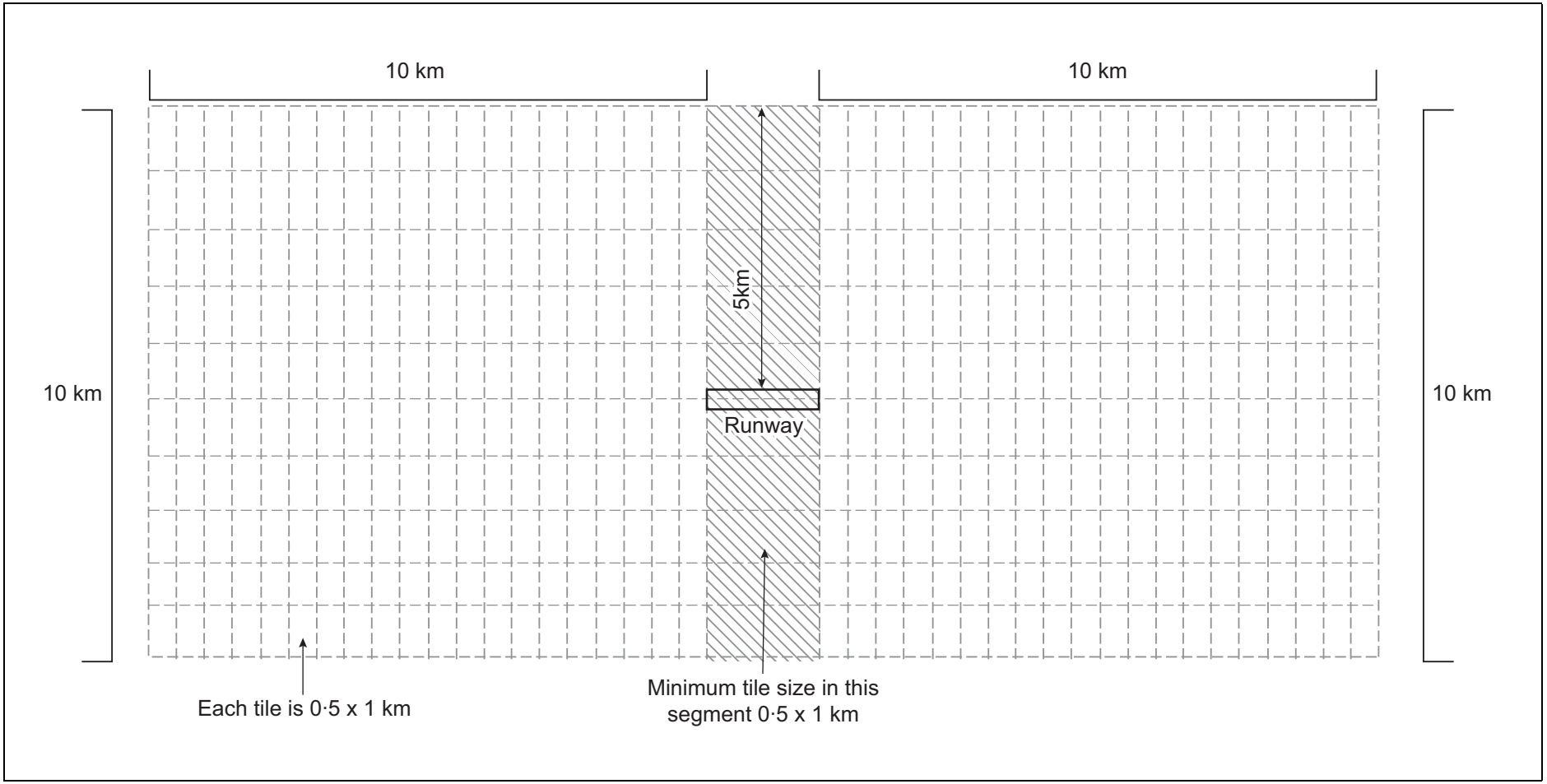

Figure 3 Non - Precision Instrument Approach Area

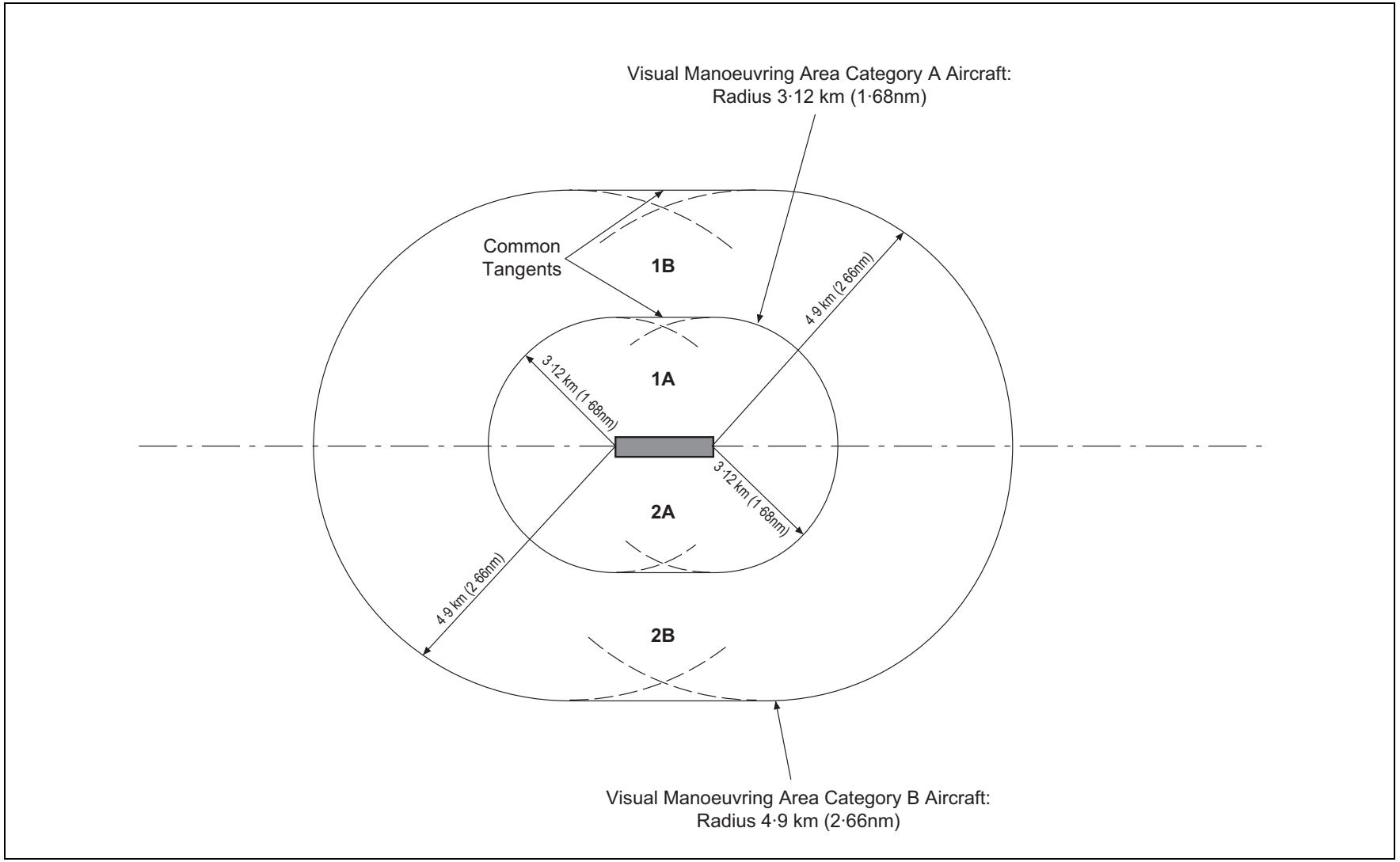

Figure 4 Visual Manoeuvring (Circling) Areas Construction: Aircraft Categories A and B

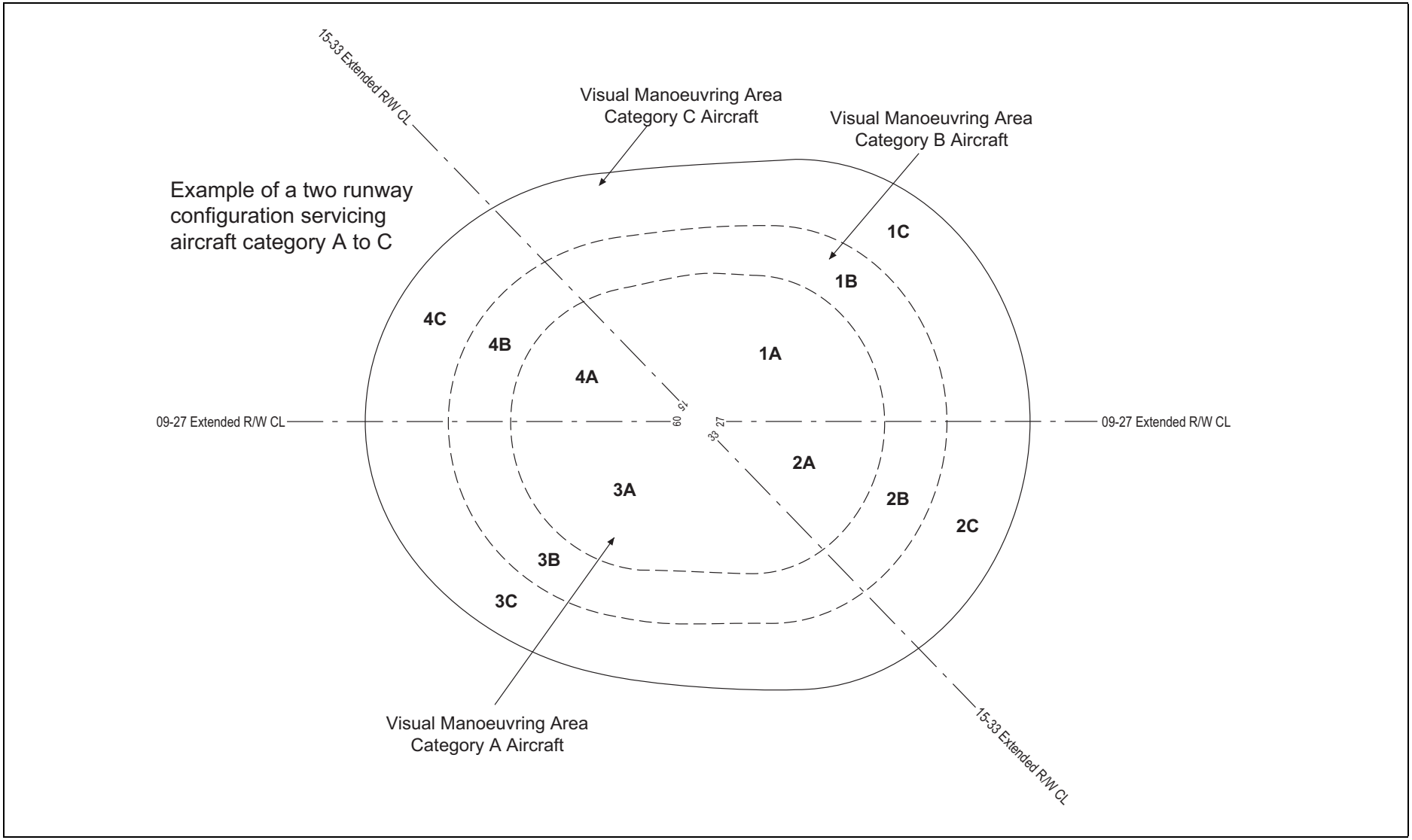

Figure 5 Example - Visual Manoeuvring (Circling) Areas

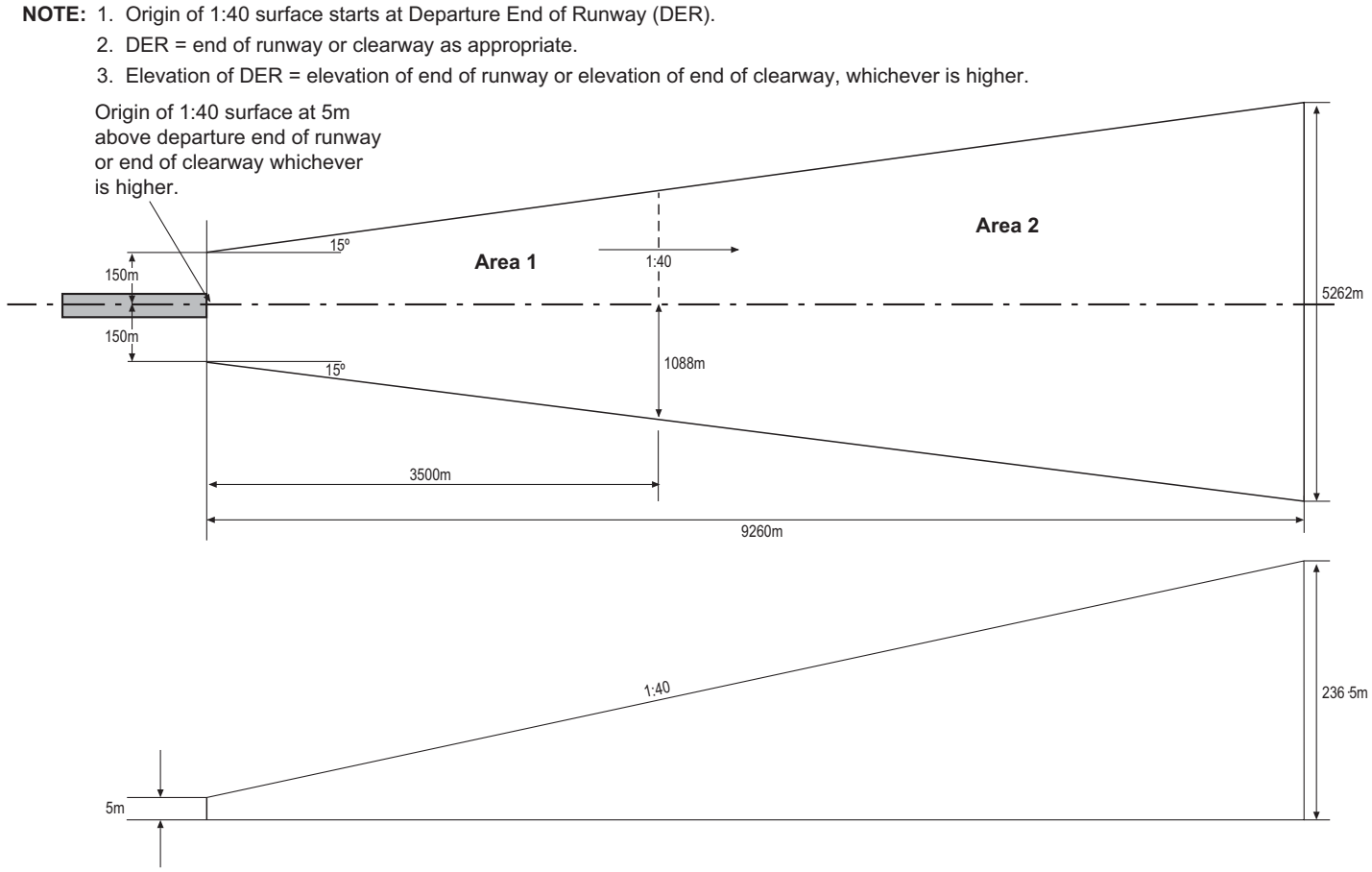

Figure 6 Departure Area 1 and 2
NOTE: Area 2 may vary according to Departure Procedure Design requirements

Chapter 8 Aerodrome Obstacle Chart - ICAO Type A Survey Area

1 Purpose

1.1 The Type A chart provides data necessary to enable the aircraft operator to comply with the operating limitations of ICAO Annex 6 - Operation of Aircraft.

1.2 Aerodrome Obstacle Charts - ICAO Type A (Operating Limitations) shall be made available (as prescribed in ICAO Annex 4 Aeronautical Charts) for all runways used by Performance Group A aeroplanes engaged in Public Transport flights. Runways that do not have obstacles in the take-off flight path (TOFP) areas shall be recorded as not requiring a Type A chart.

1.3 The CAA will undertake the preparation of the Type A chart from the information supplied by the surveyor. The CAA will determine which obstacles are to be shown on the final Type A chart by the application of complex shadowing techniques.

2 Survey Specification

2.1 Aerodrome Area

2.1.1 The elevation AMSL, at the start and end of TORA, end of ASDA and end of TODA, and at regular intervals (maximum 200 metres) along the runway and clearway centreline shall be provided.

2.1.2 The type of clearway and declared distances for TORA, TODA, ASDA and LDA shall be stated in the Survey Report. If these have not already been agreed with ASD SRG they must be submitted for verification before the Survey is started. Definitions are stated in CAP 168.

2.2 Take-Off Flight Path (TOFP) Area

2.2.1 The area to be surveyed originates at the end of the TODA. It is 180m wide at origin, symmetrical about the extended centreline and increases uniformly at a rate of 0.25D to a maximum width of 1800m, where D is the distance from origin. At a distance of 6480m it extends at the maximum width to a distance of 10000m. The elevation of the origin is the elevation declared for the end of TODA (see Figure 7).

2.2.2 The flight path plane surface has an upward slope of 1.2% from the origin (see Figure 7).

2.2.3 All objects and terrain within the TOFP area shall be comprehensively analysed. All obstacles that penetrate the TOFP surface shall be surveyed except where such obstacles are in the shadow of others. The shadow of an obstacle is considered to be a plane surface originating at a horizontal line passing through the top of the obstacle at right angles to the centreline of the TOFP, and extended to cover the complete width of the area. Frangible and mobile obstacles shall not shadow other obstacles. If the obstacle creating a shadow is likely to be removed, objects that would become dominant by its removal shall be surveyed. If the surveyor is unclear as to which obstacles are dominant then all obstacles penetrating the surface shall be surveyed.

2.2.4 For runways serving aircraft having operational limitations that do not preclude the use of a gradient less than 1.2%, the TOFP area is increased to 12000m and the slope

of the plane surface is reduced to 1% or less. Where the plane of the 1% slope does not touch any objects, it is to be reduced until it touches the first object.

2.2.5 The elevation AMSL of any road, railway track or water feature capable of supporting mobile obstacles greater than 4.8m (for waterways the high and low water marks and the height of shipping) shall be surveyed at a regular interval to its full linear extent, until shadowed by the next dominant obstacle if the combined elevation penetrates the TOFP surface. The combined elevation shall be provided.

2.2.6 Where the TOFP is at an offset angle from the runway extended centreline in order to gain an operational advantage, the area to be surveyed shall be determined by consultation between the Aerodrome Licensee and aircraft operators concerned, and agreed with SRG, CAA and annotated in the survey report.

3 Digital Data

All surveyed obstacles shall form part of the "Master Obstacles listing" depicted in Annex B. Positional data, and associated elevations, that determines the extent of the declared distances and runway profile shall be included in the 'Aerodrome Facilities listing' depicted in Annex B.

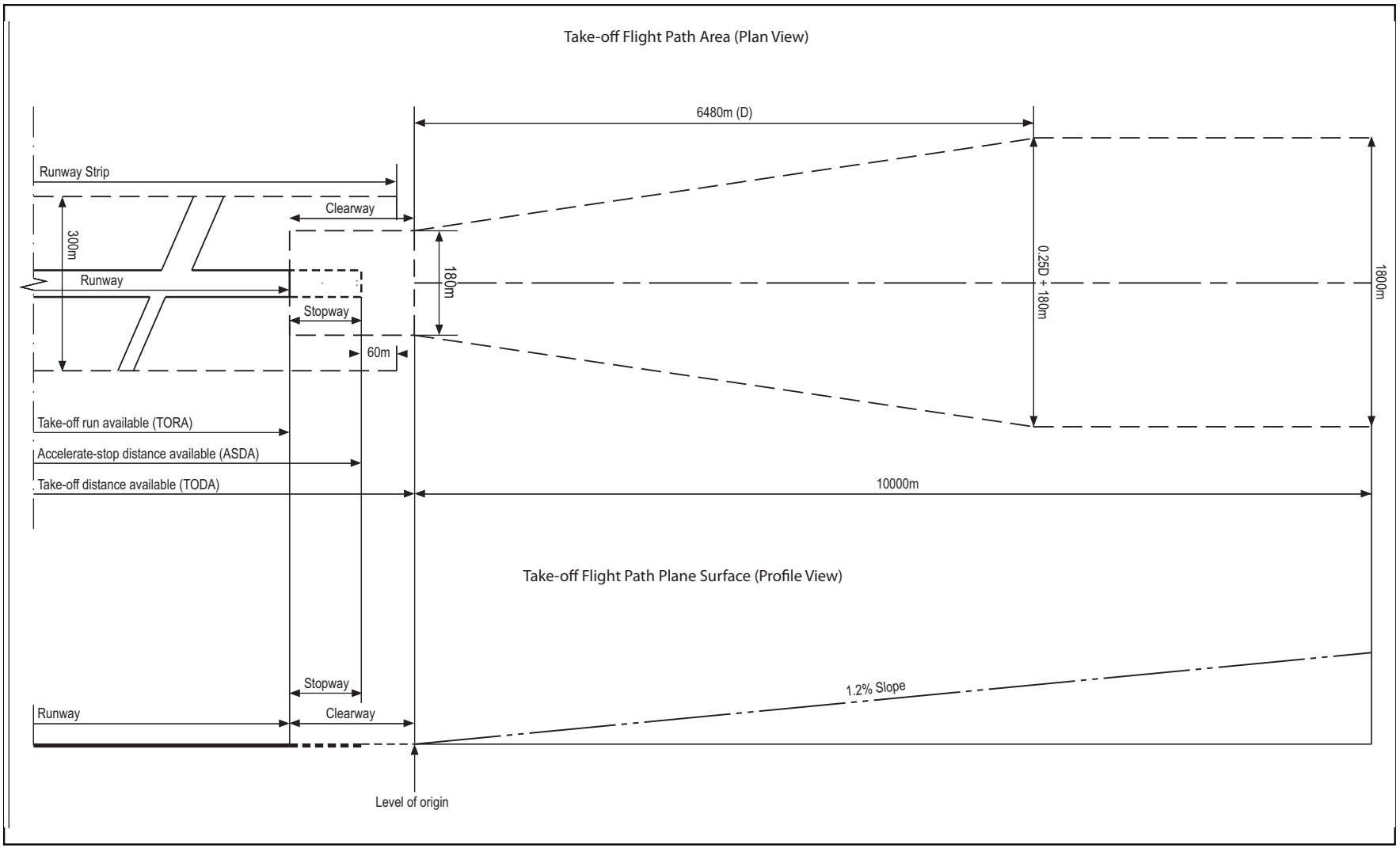

Figure 7 Type A - Take-off Flight Path Area and Plane Surface

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Chapter 9 Precision Approach Procedure Survey Area

1 Purpose

1.1 The survey is to identify obstacles within the Precision Approach area. It provides important data for the safety assessment of Precision Approach procedures and the calculation of obstacle clearance heights.

1.2 The survey provides data for use in connection with the following precision approach procedures:

- ILS (including Offset Localiser facilities)
- MLS (including Offset Azimuth facilities)

(NOTE: ILS Localiser only and MLS Azimuth only are non-precision approach procedures and survey requirements are detailed in Chapter 7.)

1.3 In the case of offset facilities (where the localiser is not aligned with the extended runway centreline), TA, DAP, CAA House should be consulted on the alignment of the survey area required.

2 Survey Specification

2.1 The ILS Basic Surfaces area is illustrated in Figure 8**.**

2.2 The survey requirement is to height all obstacles in this area that penetrate the surfaces.

3 Digital Data

All surveyed obstacles shall form part of the "Master Obstacles listing" depicted in Annex B.

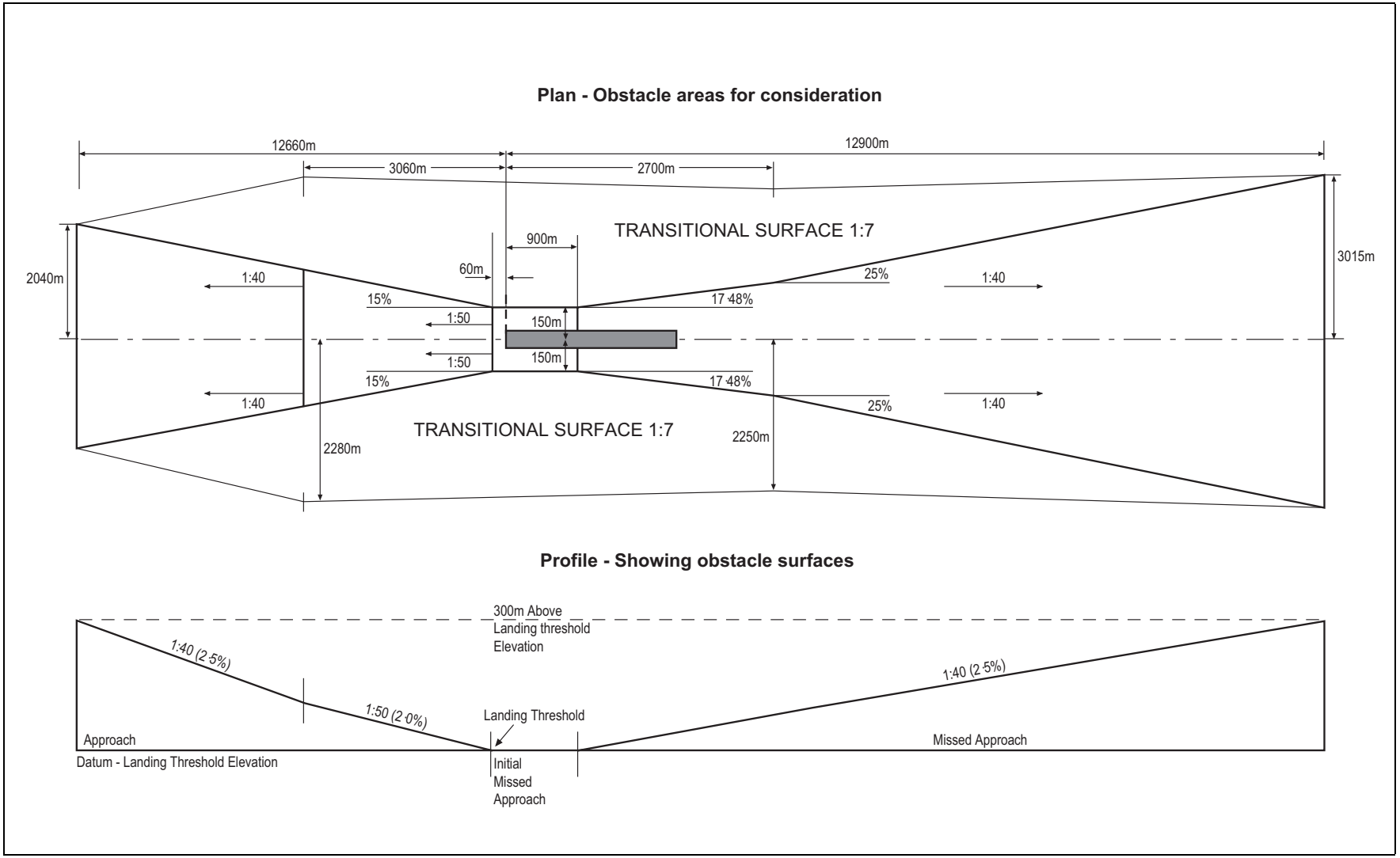

Figure 8 Basic ILS Surfaces

Chapter 10 Precision Approach Terrain Chart Survey Area

1 Purpose

1.1 The Precision Approach Terrain Chart (PATC) provides a detailed terrain profile of the final portion of a Precision Approach. It provides information to enable the evaluation of the effects of the terrain on decision height determination using radio altimeters.

1.2 It is a mandatory requirement for aerodromes that conduct Cat II, III precision approaches to provide data to the CAA to enable the preparation and publication of the PATC.

2 Survey Specification

2.1 The area for survey starts at the runway threshold and extends for a distance of 900m into the approach, 60m either side of the extended runway centre line (see Figure 9). A longitudinal extension of this area might be required if the terrain undulates significantly. Any such requirement will be identified by SRG, CAA during the initial approval process for Cat II, III operation.

2.2 Features to be surveyed:

- Runway threshold and elevation.
- Extended runway centre line terrain profile.
- All features including mobile features that are 10ft, or greater, above or below the extended runway centre line terrain level and with a horizontal dimension of more than 15m measured parallel to the runway centre line.
- Terrain contours at 3ft contour intervals related to the runway threshold height.
- Roads, railways, river or canal features shall have sufficient levels to show their surface elevation, (in the case of a body of water subject to tides, high and low tidal variations are required) and the height of the highest mobile feature that could be expected on them. The features shall include vegetation, hard, mobile and temporary objects.

3 Survey Chart Presentation

3.1 The base map shall be at a scale of 1:2500 or where the area has been extended it shall be at 1:5000. The accepted format is listed in Chapter 3, paragraph 1.

3.2 The chart will show the survey area in plan view at either of the above scales and in cross section profile at a recommended scale of 1:500. (If the area is flat, a larger profile scale may be used).

3.3 The chart shall reflect the position, height and shape of all features that fall in the category as described in Chapter 10, paragraph 2.2 (see Figure 9).

4 Published Chart

The survey information shall be issued to the Aerodrome Licensee for approval and the data passed to CAA. The final chart is prepared and published by the CAA.

5 Chart Maintenance

5.1 It is the responsibility of the Aerodrome Licensee to monitor any changes in the approach terrain profile. If significant changes occur the Aerodrome Licensee shall notify them by NOTAM and provide appropriate new survey data to the CAA immediately.

5.2 All changes in the profile that exceed the following limits shall be recorded:

- Changes in slope of 12.5% or more over a distance of 15m or more.
- Changes in the contour height of 10ft or more (increase or decrease) and over 15m to the defined approach area.
- All features as stated in paragraph 2.2.

NOTE: It is important that both increases and decreases in elevation are significant.

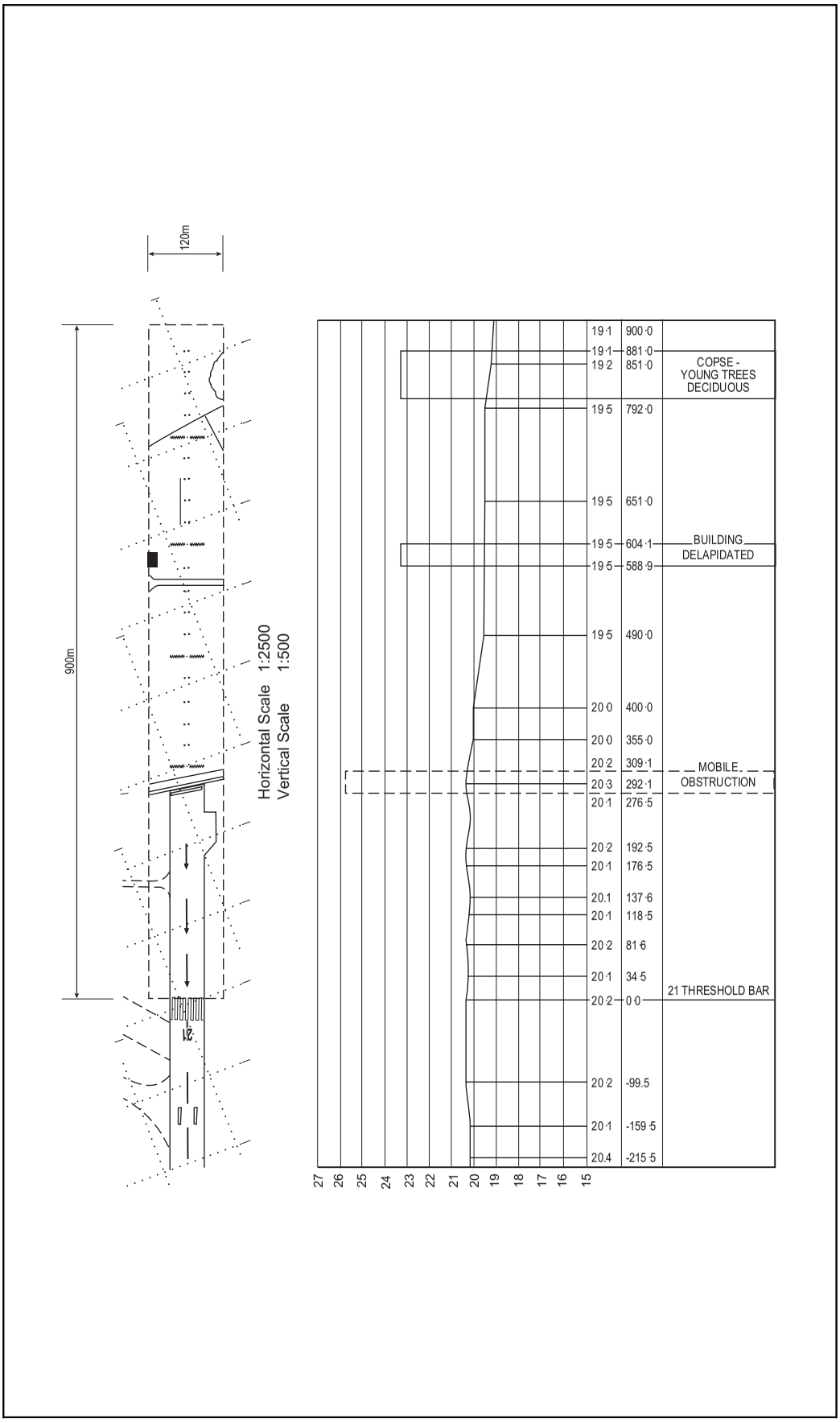

Figure 9 Precision Approach Terrain Chart

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Chapter 11 PAPI/APAPI Site Survey Area

Purpose

The survey is required to provide data to assist in the calculation for the siting of PAPI/APAPI units on initial installation. Full details are contained in CAP 168. PAPI/APAPI surveys do not form part of the full and check survey procedures.

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Annex A Survey Declaration Form

Aerodrome	
Surveying Company	

Aerodrome Classification		Initial/Last Full Survey Date	
Geodetic Connection Date*		Annual Check Survey Date*	

(* If applicable)

Survey Area Required		No Change to Previous Survey	Change to Previous Survey
Aerodrome Plan	☐	☐	☐
AGA	☐	☐	☐
Non-Precision Instrument Approach	☐	☐	☐
Visual Manoeuvring (Circling)	☐	☐	☐
Departure	☐	☐	☐
Aerodrome Obstacle Chart - Type A	☐	☐	☐
Precision Approach Procedure	☐	☐	☐
Precision Approach Terrain Chart	☐	☐	☐

(Check box as appropriate)

Declaration by Aerodrome Licensee's Representative I certify that information supplied meets the Aerodrome's operational requirements			
Name			
Position			
Signature		Date	

Declaration by Surveyor I certify that information supplied is complete and conforms to CAP 232 (Edition 3)			
Name			
Signature		Date	

Submit form together with all relevant survey information to:
ACD, DAP, CAA House, 45-59 Kingsway, London WC2B 6TE

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Annex B Digital Data Specification

Master files of all surveyed facilities and obstacles shall be created and supplied.

Files of survey information shall be in the form of a comma delimited ASCII text file containing fourteen fields plus CRC field as listed below.

Aerodrome facilities file (named appropriately e.g. egxx_ad00.crc)

	To be entered in field	Description
Field 1	SITE NAME	
	EGXX	ICAO Aerodrome Location Indicator
Field 2	TYPE OF FEATURE	
	ABN	Aerodrome Beacon
	ATC	Air Traffic Control Location
	ASDA_END	End of ASDA
	CHECK_PT1	Additional point along runway
	CHECK_PT2	Additional point along runway
	DME	Distance Measuring Equipment
	FATO	Final Approach and Take-off Area
	GP	Instrument Landing System Glidepath
	IBN	Identification Beacon
	IRVR	Instrument Runway Visual Range
	L	Locator (NDB)
	LDA_END	End of LDA
	LLZ	Instrument Landing System Localizer
	MLS_AZM	Microwave Landing System Azimuth
	MLS_ELEV	Microwave Landing System Elevation
	MM	Middle Marker
	NDB	Non-directional Radio Beacon
	OM	Outer Marker
	RADAR	RADAR
	ROP	Runway Observing Position
	STAND	Stand
	THR	Runway Threshold

	TLOF	Touchdown and Lift-off Area
	TODA_END	End of TODA
	TORA_START	Start of TORA
	TORA_END	End of TORA
	VDF	Very High Frequency Direction-finding Station
	VOR	VHF Omnidirectional Radio Range
	VOR/DME	VOR co-located with DME
Field 3	IDENTIFICATION	
	ABC	Call sign of navigation aid
	05L	Runway threshold, LLZ and GP designator
	05/23	Runway and DME designator
	123	Stand number
Field 4	LATITUDE	
	522704.83N	WGS-84 Latitude in DEG, MIN, SEC, 1/100's SEC
Field 5	LONGITUDE	
	0014431.27W	WGS-84 Longitude in DEG, MIN, SEC, 1/100's SEC
Field 6	ELLIPSOIDAL HEIGHT (M)	
	107.00	Elevation in metres above WGS-84 ellipsoid to 2 decimal places
Field 7	ELLIPSOIDAL HEIGHT (FT)	
	351.05	Elevation in feet above WGS-84 ellipsoid to 2 decimal places
Field 8	LIT OR UNLIT	
	Y	To be entered if facility is lit
	N	To be entered if facility is unlit
Field 9	EASTING	
	312567.75	Six figure easting grid reference to 2 decimal places
Field 10	NORTHING	
	435687.55	Six figure northing grid reference to 2 decimal places
Field 11	ORTHOMETRIC HEIGHT (M)	
	113.76	Elevation in metres AMSL to 2 decimal places
Field 12	ORTHOMETRIC HEIGHT (FT)	
	373.22	Elevation in feet AMSL to 2 decimal places

Field 13	RECORD IDENTIFIER	
	1056	Unique integer number
Field 14	SURVEY DATE	
	10/01/00	Date of field survey of record (dd/mm/yy format)
Field 15	CRC Value	32 bit CRC-32Q algorithm Value (CRCV format = Hexadecimal)
	AB47A43	(Created by Eurocontrol CRC tool)

Example of CRC wrapped records in file:

EGXX,NDB,ABC,522732.45N,0014429.34W,119.74,393,Y,417662.27,284592.54,70.35,231,1008,10/01/00,45F652A2
EGXX,LLZ,05L,522758.83N,0014539.27W,117.96,387,N,416246.56,285408.34,103.63,340,1010,10/01/00,E74FA6A3
EGXX,STAND,5,522701.13N,0014399.21W,115.82,380,N,418234.34,283673.22,101.5,333,1013,12/01/00,219C3FE9

Master obstacles file (named appropriately e.g. egxx_obst00.crc)

To be entered in field	**Description**
Field 1 SITE NAME	
EGXX	ICAO Aerodrome Location Indicator
Field 2 TYPE OF FEATURE	
OBST	Obstacle
Field 3 IDENTIFICATION	
BUILDING	Description of obstacle
Field 4 LATITUDE	
522704.83N	WGS-84 Latitude in DEG, MIN, SEC, 1/100's SEC
Field 5 LONGITUDE	
0014431.27W	WGS-84 Longitude in DEG, MIN, SEC, 1/100's SEC
Field 6 ELLIPSOIDAL HEIGHT (M)	
107.00	Elevation in metres above WGS-84 ellipsoid to 2 decimal places
Field 7 ELLIPSOIDAL HEIGHT (FT)	
351.05	Elevation in feet above WGS-84 ellipsoid to 2 decimal places
Field 8 LIT OR UNLIT	
Y	To be entered if obstacle is lit
N	To be entered if obstacle is unlit
Field 9 EASTING	
312567.75	Six figure easting grid reference to 2 decimal places

Field 10 NORTHING

435687.55	Six figure northing grid reference to 2 decimal places

Field 11 ORTHOMETRIC HEIGHT (M)

113.76	Elevation in metres AMSL to 2 decimal places

Field 12 ORTHOMETRIC HEIGHT (FT)

373.22	Elevation in feet AMSL to 2 decimal places

Field 13 RECORD IDENTIFIER

1056	Unique integer number

Field 14 SURVEY DATE

10/01/00	Date of field survey of record (dd/mm/yy format)

Field 15 CRC Value

AB47A43	32 bit CRC-32Q algorithm Value (CRCV format = Hexadecimal) (Created by Eurocontrol CRC tool)

Example of CRC wrapped records in file:

EGXX,OBST,TREE,533211.60N,0002217.25W,322,136.24,447,N,376673.45,404383.54,98.15,322,1001,10/01/00,AB47A43
EGXX,OBST,CHURCH_SPIRE,533659.04N,0002001.07W,121.31,398,Y,399978.89,413280.67,74.98,246,1002,10/01/00,86789C79
EGXX,OBST,MAST,532725.46N,0001918.10W,222.20,729,Y,511435.56,396978.78,175.87,577,1003,10/01/00,5A6B1656
EGXX,OBST,RADAR,532619.85N,0001818.85W,249.63,819,Y,512713.38,394913.55,203.30,667,1005,10/01/00,EB6EB575
EGXX,OBST,PYLON,533029.93N,0001819.19W,223.42,733,N,512407.45,402640.98,177.09,581,1008,10/01/00,230E3C1D

Special Notes:

- Decimal places shall not be rounded.
- Only decimal places, underscores and forward slashes shall be used within fields (no hyphens, word spaces, commas or backslashes, etc.).
- All text shall be upper case.
- All fields shall be populated with the exception of the aerodrome facilities file Field 3, which must be blank if there is no associated identification (Duplicate data in a record is not acceptable).

Annex C Methodology of Modelling Obstacles (For information only)

1 Introduction

The ILS Collision Risk Model (CRM) requires position and dimension data for all relevant obstacles. The data can be entered in the co-ordinate system (x,y,z) or converted from other co-ordinate systems to the (x,y,z) system.

2 Description of Artificial Obstacles

For processing by the CRM, obstacles must be of a specific form: either as a spike or a wall as shown below (see Figure10). For the purposes of the CRM, therefore, obstacles after adjustment (see paragraph 5) have height and width but do not have length.

3 Simple Obstacle Modelling

Obstacles are usually of a complex shape, unlikely to be orientated at right angles to the line of approach, and may well extend longitudinally for considerable distance. These can be expressed as a number of simple obstacles as spikes or a series of walls (see Figures 11 and 12).

In general obstacle modelling should be as simple as possible with conservative dimensions assigned.

4 Sophisticated Obstacle Modelling

4.1 If analysis of the CRM results shows that the precise shape of an obstacle is critical with respect to the total risk, a more sophisticated obstacle model may be required as detailed below:

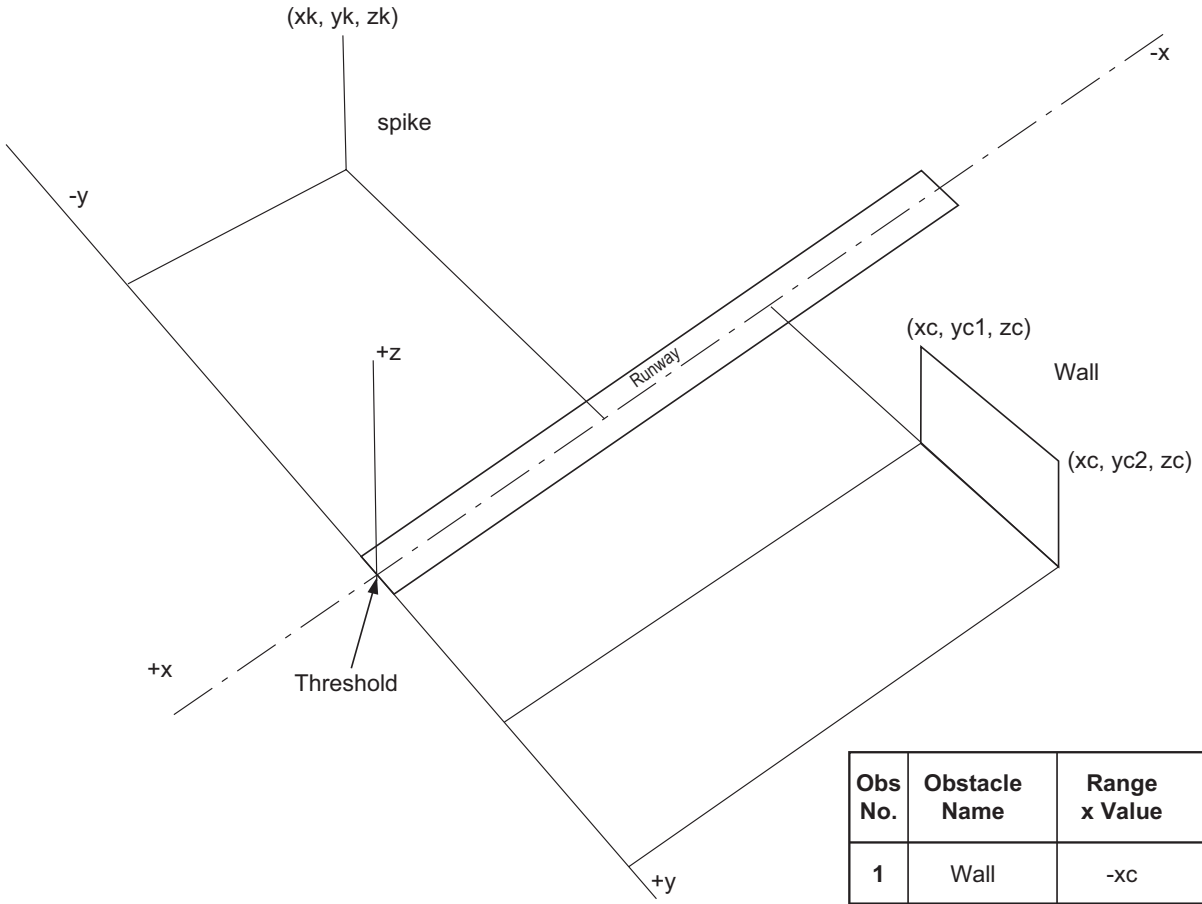
- Construct lines parallel to the x axis through y1 and y2, the outer edges of the obstacle in the y axis. The perpendicular distances from these lines to the x axis are the lateral boundary dimensions.
- The height (z) of the obstacle is taken to be that of the highest point above threshold elevation.
- The range (x) is the perpendicular distance from the obstacle boundary point nearest to the threshold.

4.2 If a solid obstacle is modelled by spike obstacles, lateral spacing should be not more than the wing span of the largest aircraft likely to use the airport.

4.3 If the difference between the most distant point and the nearest point of the obstacle to the threshold exceeds 100m, the obstacle should be partitioned into a series of wall obstacles separated by no more than 100m in range. The height assigned to such a "wall" obstacle should be the highest elevation of the obstacle in the area away from the runway. In cases where the obstacle height varies with distance from the centre line, each wall may be broken up into two or more adjacent walls.

5 Considerations on Accuracy

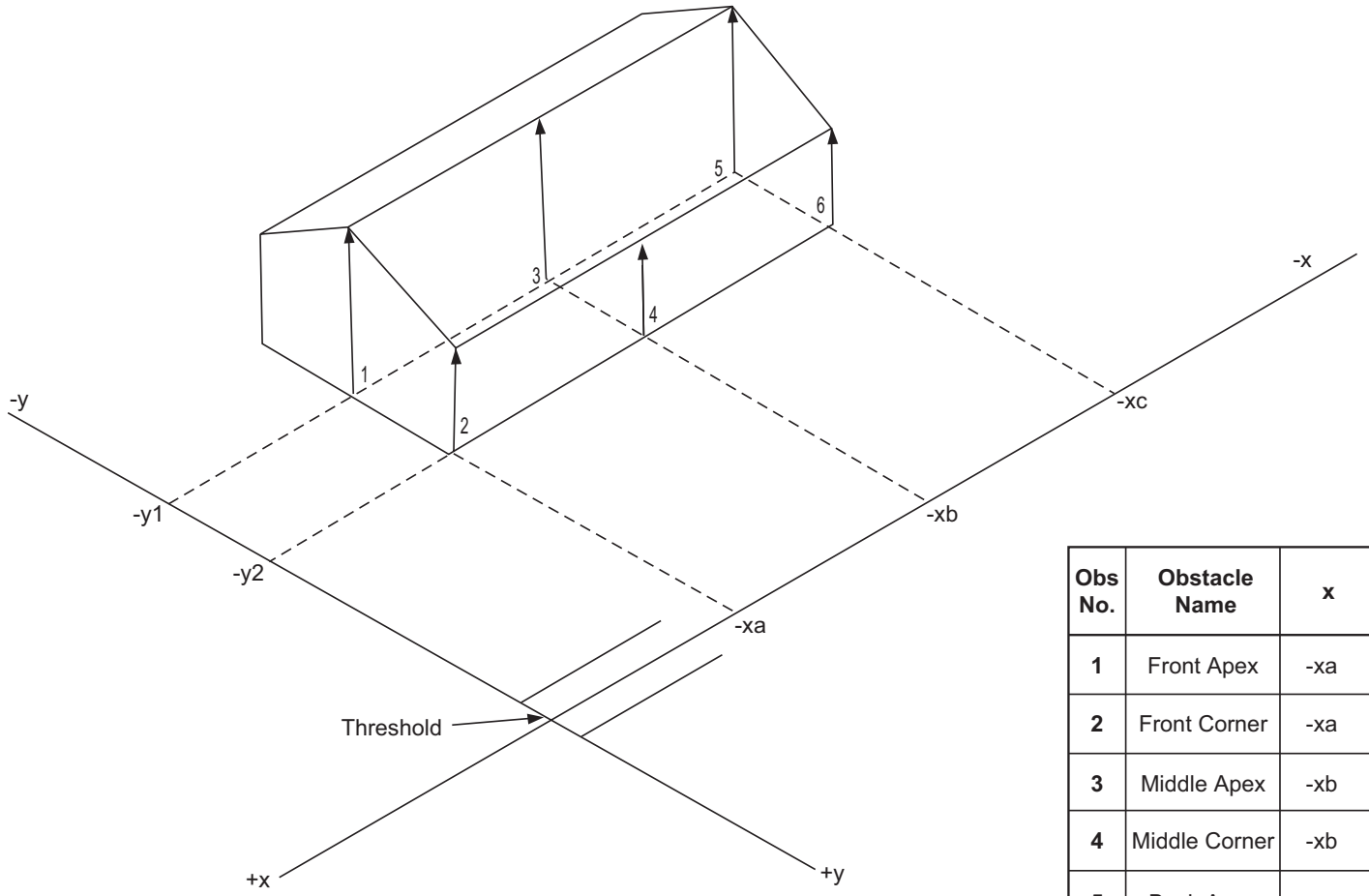
Consideration should be given to the accuracy with which the obstacle data has been collected. Suitable adjustments should be made to take account of inaccuracies in the obstacle data; these should result in a greater height, a smaller (absolute) range, and a smaller (absolute) lateral displacement. If these adjustments lead to unacceptable operational penalties, more accurate surveying may reduce these penalties. In addition adjustments for such things as tree growth may be taken into account by adding a tolerance to the height.



Obs No.	Obstacle Name	Range x Value	y1	y2	Z*
1	Wall	-xc	yc1	yc2	zc
2	Spike	-xk	yk	yk	zk

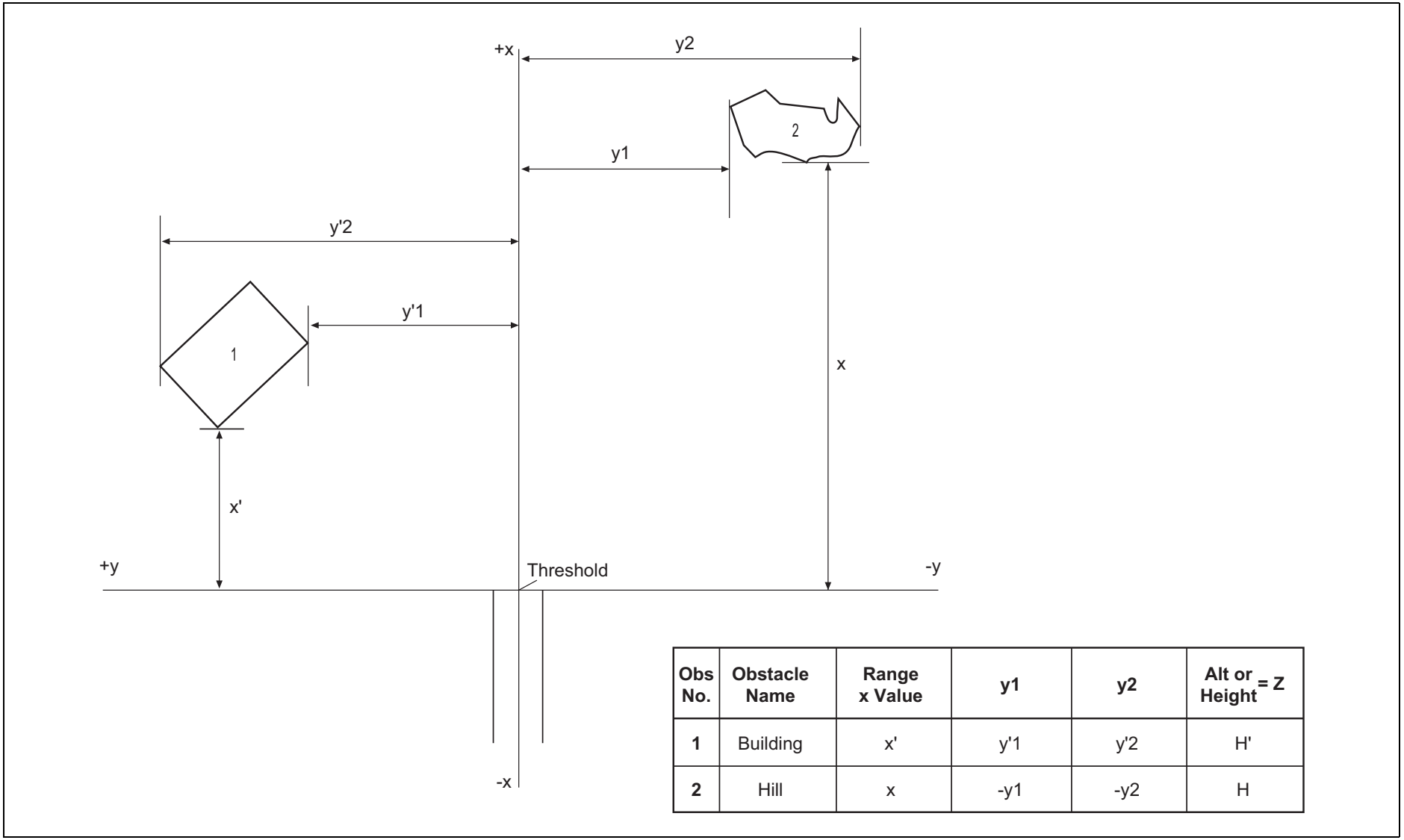
* NOTE: Z = Height above Threshold.

Figure 10 Spike and Wall Obstacles as Required by the ILS CRM



Obs No.	Obstacle Name	x	y1	y2	z
1	Front Apex	-xa	-y1	-y1	za
2	Front Corner	-xa	-y2	-y2	zb
3	Middle Apex	-xb	-y1	-y1	za
4	Middle Corner	-xb	-y2	-y2	zb
5	Back Apex	-xc	-y1	-y1	za
6	Back Corner	-xc	-y2	-y2	zb

Figure 11 Example of Obstacle Modelling



Obs No.	Obstacle Name	Range x Value	y1	y2	Alt or Height = Z
1	Building	x'	y'1	y'2	H'
2	Hill	x	-y1	-y2	H

Figure 12 Examples of Irregular Shaped Obstacles

Obs No.	Obstacle Name	x	y1	y2	z
A1	Building A	x1	y1	y2	z1
A2	Building A	x2	y3	y4	z1
A3	Building A	x3	y5	y6	z1

Obs No.	Obstacle Name	x	y1	y2	z
B1	Building B	x6	-y1	-y2	z2
B2	Building B	x5	-y1	-y2	z2
B3	Building B	x4	-y1	-y2	z2
B4	Building B	x1	-y1	-y2	z2

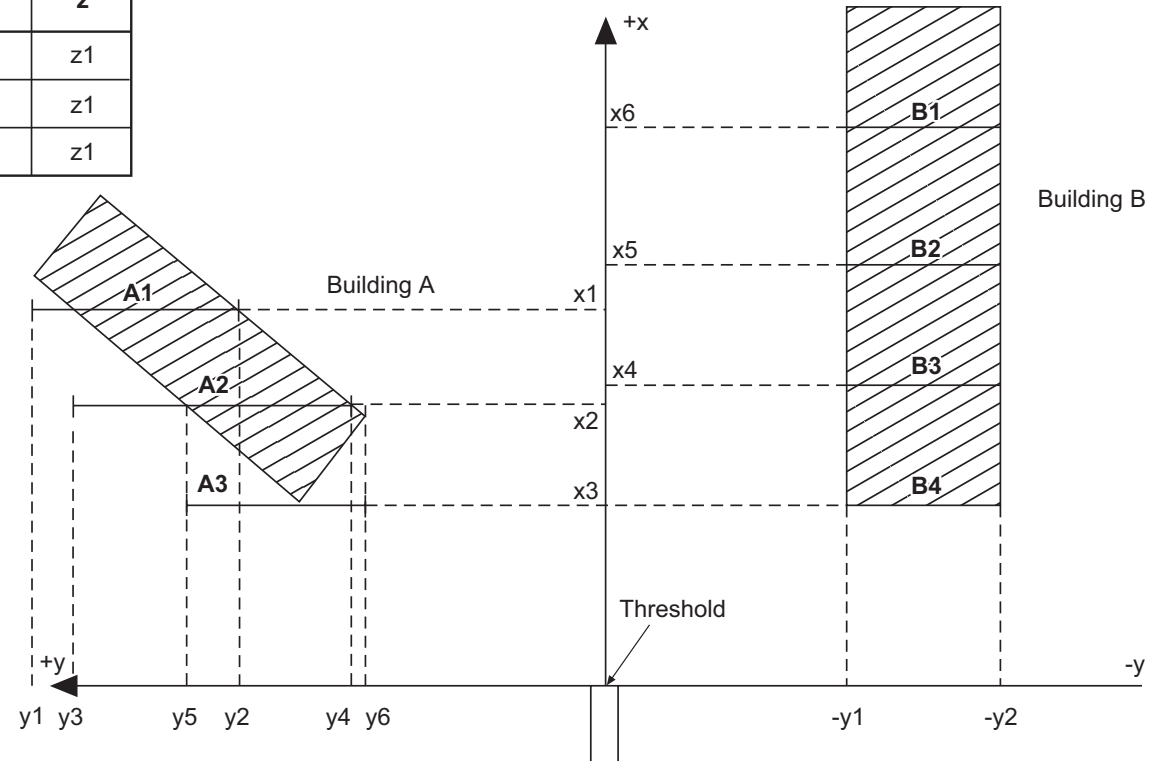
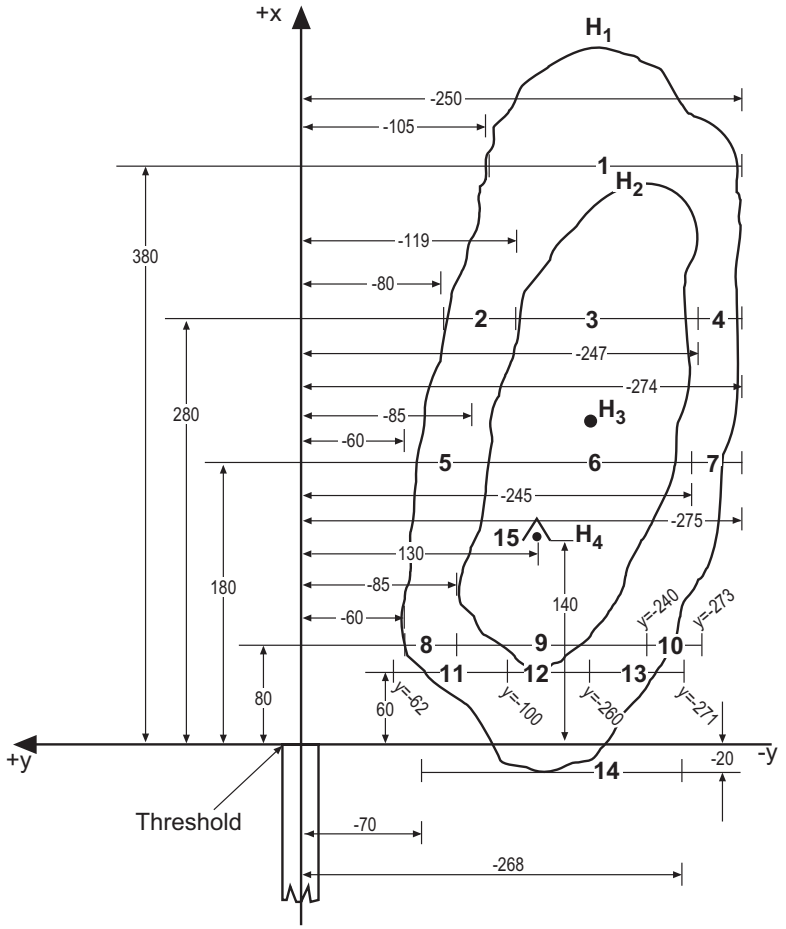


Figure 13 Partitioning of Continuous Obstacles (Buildings)



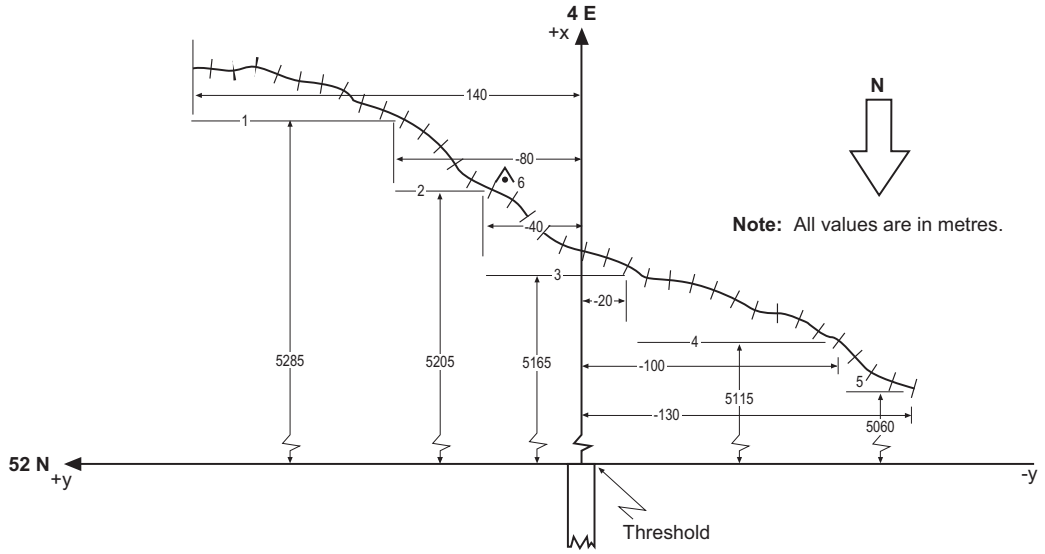
Obs No.	Obstacle Name	Range x Value	y1	y2	Obstacle Height* = Z
1	Hill	380	-105	-250	$H_2 + T_g$
2	Hill	280	-80	-119	$H_2 + T_g$
3	Hill	280	-119	-247	$H_3 + T_g$
4	Hill	280	-247	-274	$H_2 + T_g$
5	Hill	180	-60	-85	$H_2 + T_g$
6	Hill	180	-85	-245	$H_3 + T_g$
7	Hill	180	-245	-275	$H_2 + T_g$
8	Hill	80	-60	-85	$H_2 + T_g$
9	Hill	80	-85	-240	$H_3 + T_g$
10	Hill	80	-240	-273	$H_2 + T_g$
11	Hill	60	-62	-100	$H_2 + T_g$
12	Hill	60	-100	-260	$H_3 + T_g$
13	Hill	60	-260	-2271	$H_2 + T_g$
14	Hill	-20	-70	-268	$H_2 + T_g$
15	Tower	140	-130	-130	H_4

* Z = Height above Threshold.

Tg is an allowance for tree height or growth.

All values are in metres.

Figure 14 Partitioning of a Continuous Obstacle (Hill)



Obs No.	Obstacle Name	Runway Co-ordinate System			Obstacle Height* (m) above Thld	Geographical Co-ordinate System											
						x				y1				y2			
		x(m)	y1(m)	y2(m)		N/S	degrees	minutes	seconds	E/W	degrees	minutes	seconds	E/W	degrees	minutes	seconds
1	Railway	5285	80	140	127	N	51	57	08·78	E	4	00	04·21	E	4	00	07·37
2	Railway	5205	40	80	125	N	51	57	11·37	E	4	00	02·10	E	4	00	04·21
3	Railway	5165	-20	40	121	N	51	57	12·67	E	3	59	58·95	E	4	00	02·10
4	Railway	5115	-20	-100	125	N	51	57	14·29	E	3	59	58·95	E	3	59	54·74
5	Railway	5060	-100	-130	120	N	51	57	16·07	E	3	59	54·74	E	3	59	53·16
6	Tower	5215	40	40	155	N	51	57	11·05	E	4	00	02·10	E	4	00	04·10

* If the obstacle is a road or railway interval, use the maximum height in the interval of the road or railway.

Figure 15 Method of Partitioning a Continuous Obstacle (Railway)