Vertiport Design Proposal for Existing Aerodromes

1. Introduction

The UK Civil Aviation Authority (CAA) has launched a consultation on proposals for existing aerodromes that wish to accommodate VTOL aircraft. We anticipate that the initial eVTOL flights will take place from existing infrastructure, hence this consultation only applies to existing aerodromes and not bespoke vertiports.

These proposals apply to all land-based aerodromes that wish to incorporate an area or "vertiport" for commercial VTOL aircraft operations. This design proposal is for VTOL aircraft in day and night Visual Flight Rule (VFR) operations; it does not cater for Instrument Flight Rules (IFR) and operations under Instrument Meteorological Conditions (IMC).

The CAA defines a vertiport as a type of aerodrome or operating site that is used or intended to be used for the arrival, departure, and surface movement of VTOL aircraft.

The CAA are consulting on aerodrome design where vertiports or areas for VTOL aircraft operations differ from that of traditional aerodromes. Comments from this consultation will inform our final design proposals that will form the requirements to supplement:

- UK Reg (EU) No 139/2014 for certified aerodromes
- CAP 168: Licensing of Aerodromes for licensed aerodromes
- best practises for vertiport implementation at unlicensed aerodromes

The CAA does not have enough validated VTOL aircraft performance and design data and therefore the provisions in this document are subject to change as that relevant information becomes available. Vertiport guidance is expected to evolve into a performance-based design standard, which may require increased or decreased dimensions to those in this document.

The design proposals set out in this consultation will also form the initial basis of bespoke vertiport design, the further detail of which will be established once the VTOL aircraft manufacturers and operators provide further data.

The factors on which we are consulting will place additional requirements on existing aerodromes should they want to establish VTOL aircraft operations. This includes the physical characteristics of the operating environment such as the design of operating areas, obstacle limitation surfaces and visual aids, as well as rescue and firefighting services. One fundamental licensing criterion requires the licence holder to establish and maintain an appropriate Safety Management System (SMS). This will remain the same as for all licensed aerodromes.

The CAA is in parallel considering the circumstances in which unlicensed aerodromes that are looking to establish commercial VTOL aircraft operations, or a vertiport, may be required to obtain a licence. We will continue to engage with stakeholders on our initial proposals and carry out a separate consultation process in due course.

International Civil Aviation Organization (ICAO) documentation does not currently support the novel inclusion of VTOL aircraft operations at an existing aerodrome. Where required, ICAO Annex 14 Vols I and II, as well as Document 9261: The Heliport Manual, have been consulted. The specifications provided for in this chapter are based on the principles of heliport and helicopter design, and on statistical analysis of the population of helicopters as described in Appendix A to Chapter 3 of the Heliport Manual. A review of the design specifications will be required for vertiport regulations once information from VTOL aircraft manufacturers has been made available.

2. Terms and Definitions

D-Value. The diameter of the smallest circle enclosing the VTOL aircraft projection on a horizontal plane, while the aircraft is in the take-off or landing configuration, with rotor(s) turning, if applicable (see figure 3.1).

Final Approach and Take-off Area (FATO). The defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced.

Elongated FATO/TLOF. A FATO or TLOF where the length of the area is more than twice its width.

Protection Area. A defined area surrounding a stand intended to reduce the risk of damage from VTOL aircraft accidently diverging from the stand.

Runway-type FATO. A final-approach and take-off area (FATO) that has characteristics similar in shape to a runway.

Safety Area. A defined area on a vertiport, which surrounds the FATO and is free of obstacles, other than those required for air navigation purposes, and which is intended to reduce the risk of damage to VTOL aircraft accidentally diverging from the FATO.

Touchdown and lift-off area (TLOF). An area on which a VTOL aircraft may touch down or lift-off.

Touchdown positioning marking (TDPM). The reference marking for a normal touchdown, which is so located that when the pilot's seat is over the marking, the whole of the undercarriage will be within the touchdown and lift-off area (TLOF) and all parts of the VTOL aircraft will be clear of any obstacles by a safe margin.

Vertiport. A type of aerodrome or operating site that is used or intended to be used for the arrival, departure, and surface movement of VTOL aircraft.

Vertiport Clearway. A defined horizontal surface selected and/or prepared as a suitable area over which a VTOL aircraft may operate between the FATO and the approach/climb-out surface inner edge.

Vertiport Stand. An aircraft stand which provides parking for a VTOL aircraft and where ground taxi operations are completed or where the helicopter touches down and lifts off for air taxi operations.

Vertiport taxiways and taxi-routes. Defined paths on a vertiport established for the taxiing of VTOL aircraft between one area of the vertiport and another and intended for the safety of simultaneous operations during manoeuvring. The effects of downwash and outwash need to be taken into consideration.

VTOL aircraft. A heavier-than-air aircraft, other than aeroplane or helicopter, capable of performing vertical take-off and landing by means of more than two lift/thrust units that are used to provide lift during the take-off and landing.

Note: The above-mentioned definitions are in addition to those listed in CAP 168: Licensing of Aerodromes.

3. VTOL Operating Areas

3.1. Final approach and take-off areas

3.1.1. A vertiport should be provided with at least one final approach and take-off area (FATO).

3.1.2. A FATO in proximity to other infrastructure and objects should be located to minimise:

(a) the influence of the surrounding environment, including structure-induced turbulence.

(b) the influence of, and on, the surrounding traffic, including wake turbulence, where simultaneous aircraft operations are intended.

(c) the influence of outwash and downwash created by a VTOL aircraft.

3.1.3. A FATO should be obstacle-free. When collocated with the touchdown and lift-off area (TLOF), TLOF arrays of segmented point source lighting (ASPSL) or luminescent panels (LPs) with a height not more than 5 cm can be provided for the installation of visual aids.

3.1.4. A FATO intended to be used by VTOL aircraft should measure no less than 1.5 of D-value (D) of the largest aircraft the FATO is intended to serve. For more information on the D of a VTOL aircraft see Figure 3.1.

3.1.5. The surface of the FATO should:

(a) be resistant to the effects of outwash and downwash;

(b) be free of irregularities that would adversely affect the take-off or landing of VTOL aircraft;

(c) have bearing strength sufficient to accommodate a rejected take-off by the heaviest aircraft the FATO is intended to serve;

(d) provide ground effect;

(e) have a mean slope in any direction which should not exceed 3 percent; and

(f) provide rapid drainage.

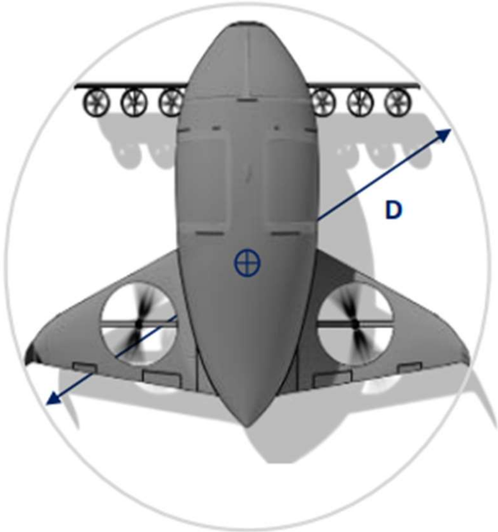


Figure 3.1 - The D-value is the diameter of the smallest circle enclosing the VTOL aircraft projection on a horizontal plane, while the aircraft is in the take-off or landing configuration, with rotor(s) turning, if applicable. Publish D in metres, rounded up to the next tenth. If the VTOL aircraft changes dimension during taxi or parking, for example folding wings, a corresponding D-taxi and D-parking should also be provided. (Illustration: EASA-PTS-VPT-DSN)

3.1.6. A FATO should be surrounded by a safety area.

3.1.7. Key considerations for operations at an aerodrome:

(a) A FATO may not be necessary to be provided where a runway is used for the purposes of the final approach and take-off of VTOL aircraft.

(b) Where a FATO is located near a runway or taxiway, and when simultaneous VTOL aircraft and aeroplane operations are planned, the separation distance between the edge of a runway or taxiway and the edge of a FATO should not be less than the appropriate dimensions in Table 3.2.

(c) Operational limitations should be considered under certain wind conditions.

3.1.8. A FATO should not be located:

(a) near taxiway intersections or holding points where jet engine efflux is likely to cause high turbulence.

(b) near areas where aeroplane vortex wake generation is likely to occur.

(c) outwash and downwash from VTOL aircraft as provided in the Aircraft Flight Manual (AFM) is likely to affect other traffic.

If aeroplane mass and/or VTOL aircraft mass are:	Distance between FATO edge and runway edge or taxiway edge:
up to but not including 3 175 kg	60 m
3 175 kg up to but not including 5 760 kg	120 m
5 760 kg up to but not including 100 000 kg	180 m
100 000 kg and over	250 m

Table 3.2 - FATO minimum separation distance.

Note- The values specified in this table are primarily intended to mitigate risks of wake turbulence encounters. In addition to this table, when positioning a FATO intended to be used simultaneously with a nearby runway or taxiway, attention should be given to CAP 168, Chapter 3; Aerodrome physical characteristics requirements such as the minimum runway strip width. Local environment should be considered when setting the separation between the FATO and nearby infrastructure elements to ensure the safety of simultaneous operations.

3.1.9. Location of multiple FATOS in relation to each other

3.1.10. When determining the distance between two FATOs, a safety assessment should indicate that this would not adversely affect the safety of operations of a VTOL aircraft.

3.1.11. The safety assessment should take into consideration, at least the following aspects:

(a) type of operation.

(b) orientation of departure and approach flight path.

(c) balked landing procedure.

(d) the downwash and outwash data as provided in the AFM.

(e) ensuring that safety areas do not overlap.

3.1.12. It has been noted that a 60-m separation distance between two FATOs has been recognised as a reference for simultaneous VTOL aircraft landings and take-offs where the courses to be flown do not conflict. This distance can be used as a reference for conducting a safety assessment to determine whether the distance for VTOL aircraft should be adapted.

3.1.13. When there is a need to adapt a rectangular area, such as already existing runway type FATO or the runway at aerodrome, for simultaneous or quasi-simultaneous and close in space operations of VTOL aircraft, the existing rectangular area should be replaced by several FATOs in close proximity. Whether the operations can be simultaneous or not will depend on the separation of the FATOs as per the safety assessment outlined in paragraph 3.1.11.

3.2. Vertiport clearways

3.2.1. When provided, a vertiport clearway should be located beyond the end of the FATO.

3.2.2. The width of a vertiport clearway should not be less than that of the associated safety area (see Figure 3.2).

3.2.3. The ground in a vertiport clearway should not project above a plane having an upward slope of 3 percent, commencing at the periphery of the FATO.

3.2.4. An object situated in a vertiport clearway, which may endanger VTOLs in the air, should be regarded as an obstacle and should be removed.

3.2.5. Clearways need to be resistant to the effects of downwash and is free of hazards if a forced landing is required.

3.3. Touchdown and lift-off areas (TLOFs)

3.3.1. At least one TLOF should be provided at a vertiport whenever it is intended that the undercarriage of the VTOL aircraft will touch down or lift off within a FATO or stand.

3.3.2. Where the taxiway is associated with an air taxi-route, the overall protection provided for the width of the surface, the surface loading and the width of the air taxi-route should be appropriate to that provided for a TLOF/FATO or TLOF/stand.

3.3.3. One TLOF should be located within the FATO or one or more TLOFs should be collocated with VTOL aircraft stands to support VTOL aircraft that require an air taxi.

3.3.4. Multiple TLOFs may be located within runway-type FATOs.

3.3.5. The minimum dimensions of a TLOF should be of at least 0.83 D or the dimensions for a required manoeuvre as recommended in the AFM of the largest VTOL aircraft the vertiport is intending to serve, whichever is greater.

3.3.6. The TLOF surface should be constructed to:

(a) accommodate the undercarriage largest VTOL aircraft the vertiport is intending to serve.

(b) have sufficient friction to avoid skidding or slipping of both the VTOL aircraft and pedestrians.

(c) free of any obstacles that would adversely affect take-off or landing.

(d) be resistant to the effects or downwash and outwash.

(e) ensures effective drainage whilst ensuring safe aircraft operations.

3.3.7. Where the TLOF is within the FATO, the TLOF:

(a) should be dynamic load bearing.

(b) should be centred on the FATO or in the case of an elongated FATO, centred on the longitudinal axis.

(c) can be offset if the FATO is larger than the minimum required dimensions but the undercarriage should remain within the TLOF and the VTOL aircraft within the FATO.

3.3.8. Where a TLOF is co-located with a VTOL aircraft stand, the TLOF should be:

(a) be static load bearing;

(b) be capable of withstanding the traffic of the VTOLs that the area is intended to serve; and

(c) be centred on the stand.

3.3.9. Slopes on a TLOF should be sufficient to prevent accumulation of water on the surface of the area and should not exceed 2 percent in any direction.

3.4. Safety areas

3.4.1. A FATO should be surrounded by a safety area which need not be solid.

3.4.2. A safety area surrounding a FATO should extend outwards from the periphery of the FATO for a distance of at least 3 m or 0.25 D, whichever is greater, of the largest VTOL aircraft the FATO is intended to serve and:

(a) each external side of the safety area should be at least 2 D where the FATO is quadrilateral (Figure 3.2); or

(b) the outer diameter of the safety area should be at least 2 D where the FATO is circular.

3.4.3. The surface of the safety area should be treated to prevent flying debris caused by downwash and outwash.

3.4.4. When solid, the surface of the safety area abutting the FATO should be continuous with the FATO and provide adequate drainage.

3.4.5. When solid, the surface of a safety area should not project above a plane having an upward slope of 4 percent, commencing at the periphery of the FATO.

3.4.6. From the outer edge of the safety area to a distance of 10m there should be a protected side slope rising at 45 degrees which should not be penetrated by obstacles.

3.4.7. The protected side slope should not be penetrated by obstacles, except that when obstacles are located to one side of the FATO only, they may be permitted to penetrate the side slope surface.

3.4.8. No mobile object should be permitted on a safety area during VTOL aircraft operations.

3.4.9. No fixed object should be permitted above the plane of the FATO on a safety area, except for frangible objects which, because of their function, must be located on the area.

3.4.10. Objects whose function requires them to be located on the safety area should not:

(a) if located at a distance of less than 0.75 D from the centre of the FATO, penetrate a plane at a height of 5 cm above the plane of the FATO; and

(b) if located at a distance of 0.75 D or more from the centre of the FATO, penetrate a plane originating at a height of 25 cm above the plane of the FATO and sloping upwards and outwards at a gradient of 5 percent.

3.4.11. When only a single approach and take-off climb surface is provided, the need for specific protected side slopes should be determined by a safety assessment.

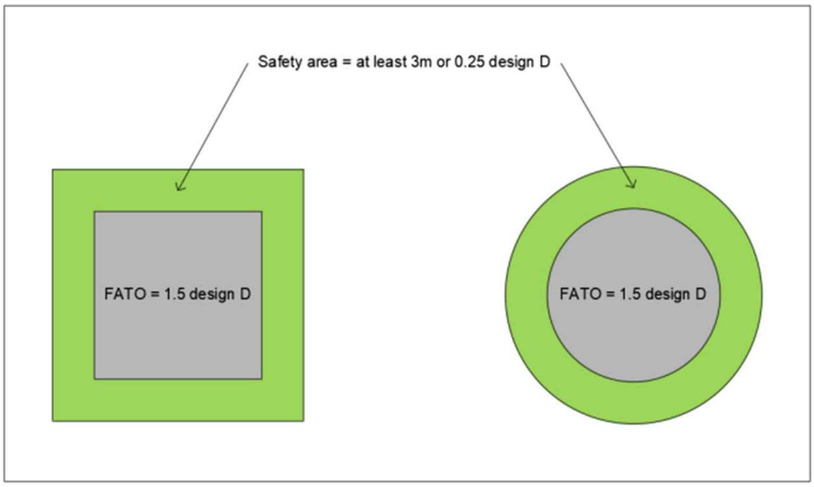


Figure 3.2 - FATO and associated safety area (Illustration: EASA PTS-VPT-DSN)

3.5. Vertiport ground taxiways and taxi-routes

3.5.1. A vertiport ground taxiway should be designed to permit the surface movement of a wheeled VTOL aircraft either under its own power or by using the appropriate ground support equipment.

3.5.2. When a taxiway is intended for use by aeroplanes, helicopters, and VTOL aircraft, the taxiway requirements for the largest aircraft type that the taxiway will serve will apply.

3.5.3. The width of a vertiport ground taxiway should not be less than 2 times the largest width of the undercarriage (UCW) of the VTOL aircraft the vertiport ground taxiway is intended to serve (Figure 3.3).

3.5.4. The longitudinal slope of a vertiport ground taxiway should not exceed 3 percent.

3.5.5. Vertiport ground taxiways and taxi-routes should be:

(a) static load-bearing and capable of withstanding the traffic of the aircraft the vertiport ground taxiway is intended to serve.

(b) free of any obstacles that would adversely affect the movement of aircraft and appropriate ground support equipment.

(c) be resistant to the effects or downwash and outwash.

(d) ensures effective drainage whilst ensuring safe aircraft operations.

3.5.6. A vertiport ground taxiway should be centred on a vertiport ground taxi-route.

3.5.7. A vertiport ground taxi-route should extend symmetrically on each side of the centre line for at least 0.75 times the largest overall width of the aircraft it is intended to serve.

3.5.8. When defining the distance between ground taxiways used by large wingspan VTOL aircraft, the separation distance between the centre line of a vertiport ground taxiway and the centre line of a parallel ground taxiway or an object should take into consideration a minimum wingtip clearance of at least 0.25 D.

3.5.9. When defining the minimum distance between a vertiport ground taxiway and another ground taxiways, fixed or movable object, the following should be considered:

(a) 0.25 maximum width of the aircraft intending to use the vertiport ground taxiway when defining the distance between the ground taxiway centre line and a fixed or movable object.

(b) 1.5 maximum width of the aircraft intending to use the vertiport ground taxiway when defining the separation between parallel ground taxiway centre lines.

3.5.10. No fixed object should be permitted above the surface on a vertiport ground taxi-route, except for frangible objects, which, because of their function, must be located there.

3.5.11. No mobile object should be permitted on a vertiport ground taxi-route during VTOL aircraft movements.

3.5.12. Objects whose function requires them to be located on a vertiport ground taxi-route should not:

(a) be located at a distance of less than 50 cm from the edge of the vertiport ground taxiway; and

(b) penetrate a plane originating at a height of 25 cm above the plane of the vertiport ground taxiway, at a distance of 50 cm from the edge of the vertiport ground taxiway and sloping upwards and outwards at a gradient of 5 percent.

(c) The vertiport ground taxiways and ground taxi-routes should provide rapid drainage, but the transverse slope of a vertiport ground taxiway should not exceed 2 percent.

(d) The surface of a vertiport ground taxi-route should be resistant to the effect of downwash and outwash.

(e) For simultaneous operations, the vertiport ground taxi-routes should not overlap.

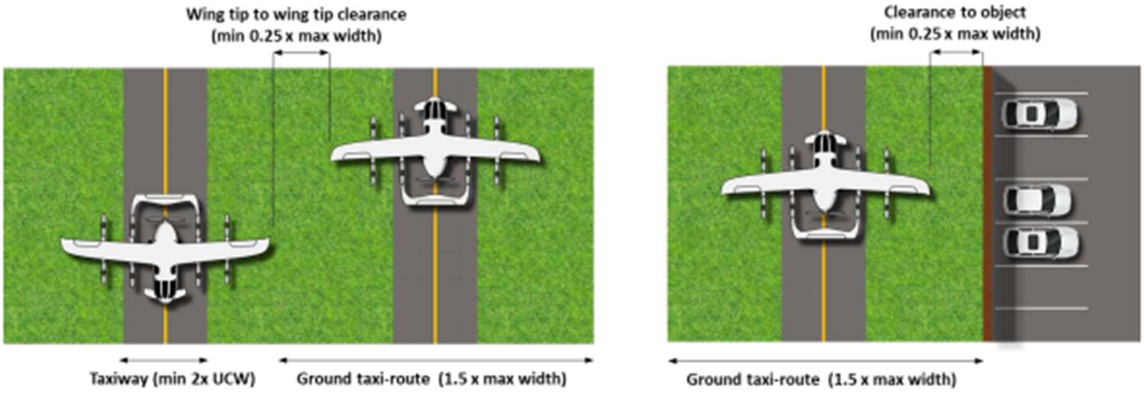


Figure 3.3 - Vertiport ground taxiway and taxi-route clearance distances (Illustration: CASA).

3.6. Vertiport air taxiways and taxi-routes

3.6.1. A vertiport air taxiway should be designed to permit the movement of a VTOL aircraft above the surface at a height normally associated with ground effect and at ground speed less than 37 km/h (20 kt).

3.6.2. The width of a vertiport air taxiway should be at least twice the largest width, including the wingspan, of the VTOL aircraft that the vertiport air taxiway is intended to serve (Figure 3.4).

3.6.3. The surface of a vertiport air taxiway should be static load bearing.

3.6.4. The slopes of the surface of a vertiport air taxiway should not exceed the slope landing limitations of the VTOL aircraft the vertiport air taxiway is intended to serve.

3.6.5. The transverse slope of a vertiport air taxiway should not exceed 10 percent.

3.6.6. The longitudinal slope of a vertiport air taxiway should not exceed 7 percent.

3.6.7. A vertiport air taxiway should be centred on a vertiport air taxi-route.

3.6.8. A vertiport air taxi-route should extend symmetrically on each side of the centre line for a distance at least equal to the largest overall width of the VTOL aircraft it is intended to serve.

3.6.9. No fixed object should be permitted above the surface on a vertiport air taxi-route, except for frangible objects, which, because of their function, must be located there.

3.6.10. No mobile object should be permitted on a vertiport air taxi-route during VTOL aircraft movements.

3.6.11. Objects above ground level whose function requires them to be located on a vertiport air taxi-route should not:

(a) be located at a distance of less than 1 m from the edge of the vertiport air taxiway, or at a distance of less than 0.5 times the largest overall width of the VTOL aircraft for which the vertiport air taxi-route is designed from the centre line of the vertiport air taxiway, whichever is greater; and

(b) penetrate a plane originating at a height of 25 cm above the plane of the vertiport air taxiway and sloping upwards and outwards at a gradient of 5 percent, at a distance of 1 m from the edge of the vertiport air taxiway, or at a distance of 0.5 times the largest overall width of the VTOL aircraft for which the vertiport air taxi-route is designed from the centreline of the vertiport air taxiway, whichever is lower.

3.6.12. The surface of a vertiport air taxi-route should be resistant to the effect of downwash and outwash.

3.6.13. The surface of a vertiport air taxi-route should provide ground effect.

3.6.14. For simultaneous operations, the vertiport air taxi-routes should not overlap.

3.6.15. The part of the vertiport air taxi-route that extends symmetrically on each side of the centre line from 0.5 times the largest overall width of the VTOL aircraft it is intended to serve to the outermost limit of the vertiport air taxi-route is its protection area.

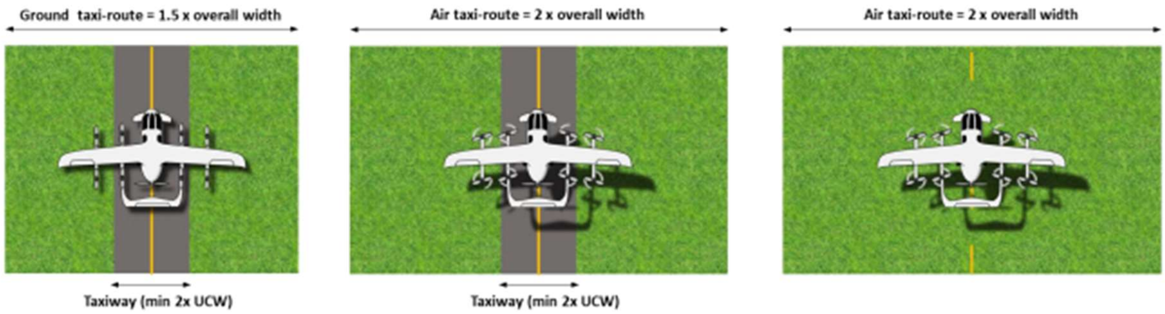


Figure 3.4 - Vertiport air taxiway and taxi-route clearance distances. (Illustration: CASA)

3.7. Vertiport stands

3.7.1. Vertiport stands and aprons should permit the safe loading and off-loading of passengers and/or cargo, as well as the servicing of VTOL aircraft without interfering with the apron traffic.

3.7.2. When determining the vertiport stand and apron layout, the vertiport designer and/or operator should take into consideration various designs of the aircraft that the aerodrome intends to serve.

3.7.3. Vertiport stands, where practicable, should be designed to be aircraft agnostic.

3.7.4. For a VTOL aircraft that enters/exits the stand with surface movement either under its own power or by means of ground movement equipment, where practical, stands may be designed in accordance with the geometry of the aircraft, following the aerodrome apron concept.

3.7.5. A space for safe ground handling should be considered by planning the vertiport stand design. In the case of a geometry-based stand, where appropriate, a tail clearance should be also provided.

3.7.6. The amount of area required for a particular apron layout depends upon the following factors:

(a) the size and manoeuvrability characteristics of the aircraft using the apron.

(b) The downwash and outwash characteristics of the VTOL aircraft as outlined in the AFM.

(c) the volume of traffic using the apron.

(d) clearance requirements.

(e) type of ingress and egress to the aircraft stand.

(f) basic terminal layout or other aerodrome use.

(g) aircraft ground activity requirements.

(h) taxiways and apron service roads.

3.7.7. It is not considered good practice to locate vertiport stands under a flight path.

3.7.8. When a TLOF is collocated with a vertiport stand, the protection area of the stand should not overlap the protection area of any other vertiport stand or associated taxi route.

3.7.9. A vertiport stand should:

(a) has bearing strength of static loads of aircraft and the weight of people, ground movement activities and handling equipment. If intended to be used or, if collocated with a TLOF, dynamic loads should be considered.

(b) have sufficient friction to avoid skidding or slipping of both the VTOL aircraft and pedestrians.

(c) free of any obstacles that would adversely affect the movement of aircraft and appropriate ground support equipment.

(d) be resistant to the effects or downwash and outwash.

(e) ensures effective drainage whilst ensuring safe aircraft operations.

(f) be associated with a protection area.

(g) The slope of a vertiport stand in any direction should not exceed 2 percent.

3.7.10. When used by VTOL aircraft turning in a hover, a vertiport stand should be of sufficient size to contain a circle of diameter of at least 1.2 D of the largest VTOL aircraft the stand is intended to serve (Figure 3.5).

3.7.11. Where a vertiport stand is intended to be used for taxi-through and where the VTOL aircraft using the stand is not required to turn, the minimum width of the stand and associated protection area should be that of the taxi-route. The vertiport stand should provide containment and space to permit all required functions of a stand to be performed.

3.7.12. Where a vertiport stand is intended to be used for turning, the minimum overall dimension of the stand and protection area should not be less than 2 D.

3.7.13. Where a vertiport stand is intended to be used for turning, it should be surrounded by a protection area which extends for a distance of 0.4 D from the edge of the vertiport stand (Figure 3.5).

3.7.14. For simultaneous operations, the protection areas of vertiport stands, and their associated taxi-routes should not overlap (Figure 3.6).

3.7.15. Where non-simultaneous operations are envisaged, the protection areas of vertiport stands, and their associated taxi-routes may overlap (Figure 3.7).

3.7.16. A vertiport stand and the associated protection area intended to be used for air taxiing should provide ground effect.

3.7.17. No fixed object should be permitted above the surface of the ground on a vertiport stand, except for tie-down points with a height of less than 5 cm, which can be accommodated if needed.

3.7.18. No fixed object should be permitted above the surface of the ground in the protection area around a vertiport stand except for frangible objects which, because of their function, must be located there.

3.7.19. No mobile object should be permitted on a vertiport stand and the associated protection area during VTOL aircraft movements.

3.7.20. Objects whose function requires them to be located in the protection area at a distance of less than 0.75 D from the centre of the vertiport stand, should not exceed 5 cm in height.

3.7.21. Objects whose function requires them to be located in the protection area should not:

(a) if located at a distance of less than 0.75 D from the centre of the vertiport stand, penetrate a plane at a height of 5 cm above the plane of the central zone; and

(b) if located at a distance of 0.75 D or more from the centre of the vertiport stand, penetrate a plane at a height of 25 cm above the plane of the central zone and sloping upwards and outwards at a gradient of 5 percent.

3.7.22. The central zone of a vertiport stand should be capable of withstanding the traffic of VTOL aircraft it is intended to serve and have a static load-bearing area:

(a) of diameter not less than 0.83 D of the largest VTOL aircraft it is intended to serve; or

(b) for a vertiport stand intended to be used for taxi-through, and where the VTOL aircraft using the stand is not required to turn, the same width as the VTOL aircraft ground taxiway.

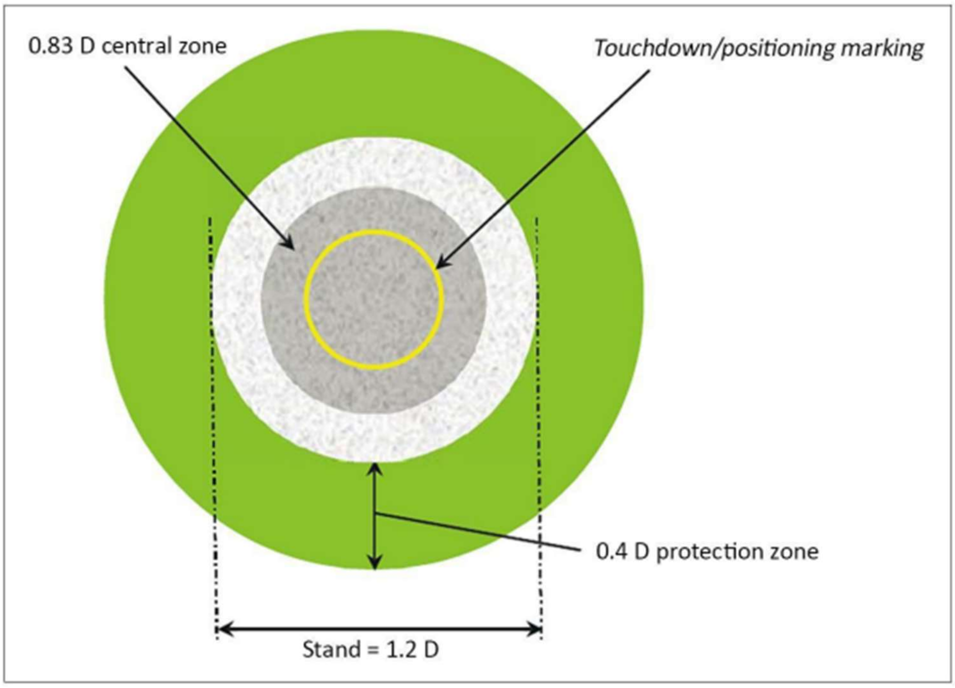


Figure 3.5 - Vertiport stand and associated protection area permitting the VTOL aircraft to turn in a hover when operating.

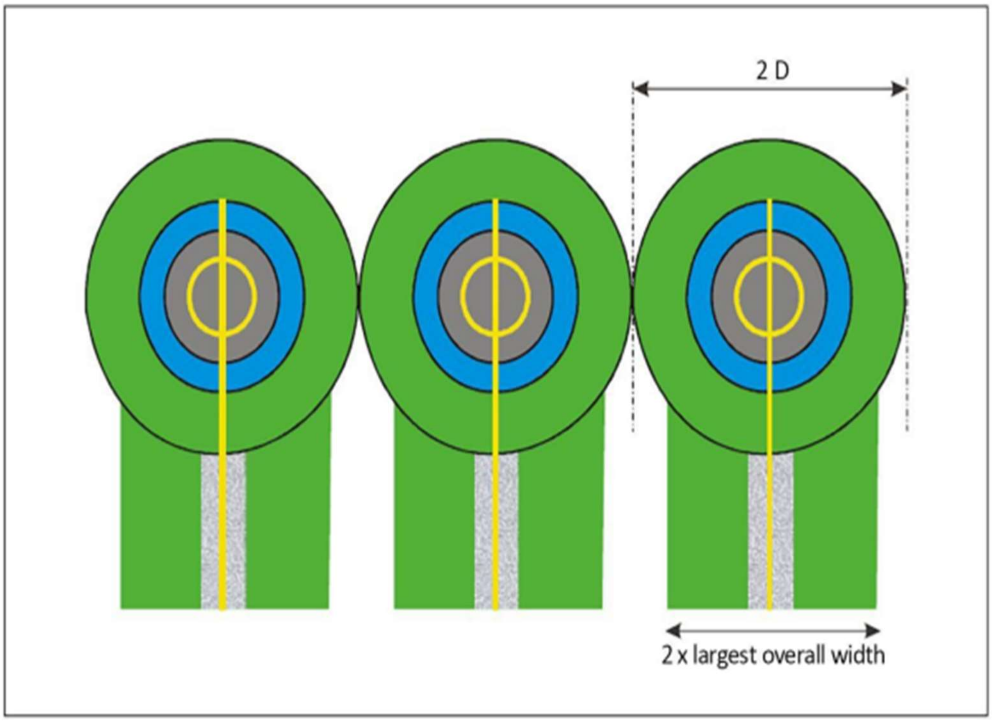


Figure 3.6 - Vertiport stand and associated protection area permitting the VTOL aircraft to turn in a hover when operating.

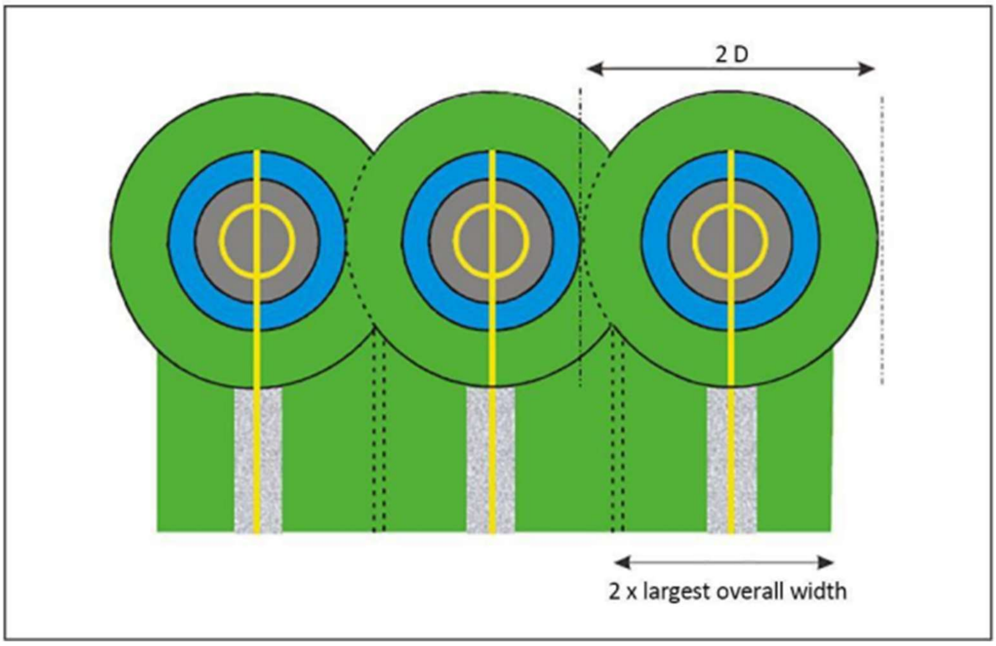


Figure 3.7 - Vertiport stands designed for hover turns with air taxi-routes/taxiways — non-simultaneous operations.

3.8. Stands used by wheeled VTOL aircraft

3.8.1. For a stand intended to be used by wheeled VTOL aircraft for turning on the ground, the dimension of the stand and the protection area, including the dimension of the central zone, would need to be significantly increased.

3.8.2. Vertiport stands designed for turning or associated with a TLOF should be defined and sized based on the D-value considerations.

3.8.3. The dimensions of a stand based on the D-value should be:

(a) a circle of diameter of 1.2 D of the largest VTOL aircraft the stand is intended to serve;

or

(b) when there is a limitation on manoeuvring and positioning, of sufficient size and shape to ensure containment of every part of the design aircraft when it is being positioned within the stand, but not less than 1.2 times overall width of largest VTOL aircraft the stand is intended to serve.

3.8.4. A protection area surrounding a stand that is D-value based does not need to be solid.

3.8.5. Each stand should be provided with positioning markings to clearly indicate where the VTOL aircraft is to be positioned and, by their form, any limitations on manoeuvring.

3.8.6. Stands designed for the surface movement of a wheeled VTOL aircraft either under its own power or by using the appropriate ground support equipment may be designed in accordance with the geometry of the aircraft, following the aerodrome apron concept.

3.8.7. The minimum dimension of a single geometry-based stand should rely on the geometry and performance of the largest VTOL aircraft intending to use the geometry-based stand and provide the following minimum clearances between an aircraft entering or exiting the stand and any adjacent building and aircraft of another stand:

(a) for VTOL aircraft with a width of less than 18 m a minimum of 3 m or 0.25 the overall width of the widest VTOL aircraft expected to use the stand, whichever is greater.

(b) for VTOL aircraft with a width greater than 18 m not less than 4.5 m.

3.8.8. minimum nose (VTOL aircraft front point) to buildings clearance on geometry based stands and/or the minimum side clearance between a VTOL aircraft entering or exiting the stand and any adjacent building may be reduced to 2 m, if a safety assessment indicates that it would not adversely affect the safety of operations of a VTOL aircraft, for example by demonstrating the accuracy of ground movement equipment used.

3.8.9. The wingtip clearance, including open prop blades should they extend beyond the wingtip, to objects and neighbouring aircraft should be at least 3 m. The wingtip clearances of neighbouring aircraft may fully overlap, in the case one is stationary.

3.8.10. The minimum wingtip clearance of 3 m assumes that there are no moving parts that extend beyond the wingtip, for example open prop blades at the tip of the wing, while entering or exiting the stand.

3.8.11. With the minimum clearance ensured as per the minimum clearances mentioned above, the geometry-based stand does not require an additional protection area surrounding it.

4. Obstacle Limitation Surfaces and Requirements

The purpose of the obstacle limitation surfaces is to define the airspace around the area on an aerodrome for the purpose for VTOL aircraft operations allowing for the safe arrival and departure of VTOL aircraft.

4.1. Approach Surface

4.1.1. The purpose of an approach surface is to protect a VTOL aircraft during the final approach to the FATO by defining an area that should be kept free from obstacles to protect a VTOL aircraft in the final phase of the approach to land manoeuvre.

4.1.2. An inclined plane or a combination of planes or, when a turn is involved, a complex surface sloping upwards from the end of the safety area and centred on a line passing through the centre of the FATO (see Figures 13.7, 13.8 and 13.9, and Table 13.2).

4.1.3. The limits of an approach surface should comprise of:

(a) an inner edge horizontal and equal in length to the minimum specified width/diameter of the FATO plus the safety area, perpendicular to the centre line of the approach surface and located at the outer edge of the safety area.

(b) two side edges originating at the ends of the inner edge diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO; and

(c) an outer edge horizontal and perpendicular to the centre line of the approach surface and at a specified height of 152 m (500 ft) above the elevation of the FATO.

4.1.4. The elevation of the inner edge should be the elevation of the FATO at the point on the inner edge that is intersected by the centre line of the approach surface. When safety assessment determines that it would not adversely affect the safety or significantly affect the regularity of operations of VTOL aircraft, the origin of the inclined plane may be raised directly above the FATO.

4.1.5. The slope(s) of the approach surface should be measured in the vertical plane containing the centre line of the surface.

4.1.6. In the case of an approach surface involving a turn, the surface should be a complex surface containing the horizontal normals to its centre line and the slope of the centre line should be the same as that for a straight approach surface (see Figure 13.9).

4.1.7. In the case of an approach surface involving a turn, the surface should not contain more than one curved portion.

4.1.8. Where a curved portion of an approach surface is provided, the sum of the radius of the arc defining the centre line of the approach surface and the length of the straight portion originating at the inner edge should not be less than 575 m.

4.1.9. Any variation in the direction of the centre line of an approach surface should be designed so as not to necessitate a turn radius less than 270 m.

4.2. Take-off climb surface

4.2.1. The purpose of the take-off climb surface is to protect a VTOL aircraft on take-off and during climb-out.

4.2.2. An inclined plane, a combination of planes or, when a turn is involved, a complex surface sloping upwards from the end of the safety area and centred on a line passing through the centre of the FATO (see Figures 4.1, 4.2, and 4.3, and Table 4.1).

4.2.3. The limits of a take-off climb surface should comprise of:

(a) an inner edge horizontal and equal in length to the minimum specified width/diameter of the FATO plus the safety area, perpendicular to the centre line of the take-off climb surface and located at the outer edge of the safety area;

(b) two side edges originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO; and

(c) an outer edge horizontal and perpendicular to the centre line of the take-off climb surface and at a specified height of 152 m (500 ft) above the elevation of the FATO.

4.2.4. The elevation of the inner edge should be the elevation of the FATO at the point on the inner edge that is intersected by the centre line of the take-off climb surface. When safety assessment determines that it would not adversely affect the safety or significantly affect the regularity of operations of VTOL aircraft, the origin of the inclined plane may be raised directly above the FATO.

4.2.5. Where a clearway is provided the elevation of the inner edge of the take-off climb surface should be located at the outer edge of the clearway at the highest point on the ground based on the centre line of the clearway.

4.2.6. In the case of a straight take-off climb surface, the slope should be measured in the vertical plane containing the centre line of the surface.

4.2.7. In the case of a take-off climb surface involving a turn, the surface should be a complex surface containing the horizontal normals to its centre line and the slope of the centre line should be the same as that for a straight take-off climb surface (see Figure 13.9).

4.2.8. In the case of a take-off climb surface involving a turn, the surface should not contain more than one curved portion.

4.2.9. Where a curved portion of a take-off climb surface is provided, the sum of the radius of the arc defining the centre line of the take-off climb surface and the length of the straight portion originating at the inner edge should not be less than 575 m.

4.2.10. Any variation in the direction of the centre line of a take-off climb surface should be designed so as not to necessitate a turn of radius less than 270 m.

4.3. Obstacle limitation requirements

4.3.1. The following obstacle limitation surfaces should be established for a FATO:

(a) take-off climb surface; and

(b) approach surface.

4.3.2. The slopes of the obstacle limitation surfaces should not be greater than, and their other dimensions not less than, those specified in Table 4.1 and should be located as shown in Figures 4.1 and 4.2.

4.3.3. Where a visual approach slope indicator is installed, additional obstacle protection surfaces should be provided, as specified in paragraph 13.32 (n), which can be more demanding than the obstacle limitation surfaces prescribed in Table 4.1.

4.3.4. For vertiports that have an approach/take-off climb surface with a 4.5 percent slope design, objects can be permitted to penetrate the obstacle limitation surface, if after a safety assessment, it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of VTOL aircraft.

4.3.5. Existing objects above the approach and take off climb surfaces should, as far as practicable, be removed except when the object is shielded by an existing immovable object or when after a safety assessment, it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of VTOL aircraft.

4.3.6. When only a single approach and take-off climb surface is provided, a safety assessment should be undertaken considering as a minimum, the following factors:

(a) the area/terrain over which the flight is being conducted.

(b) the obstacle environment surrounding the vertiport.

(c) the performance and operating limitations of VTOL aircraft intending to use the vertiport; and

(d) the local meteorological conditions including the prevailing winds.

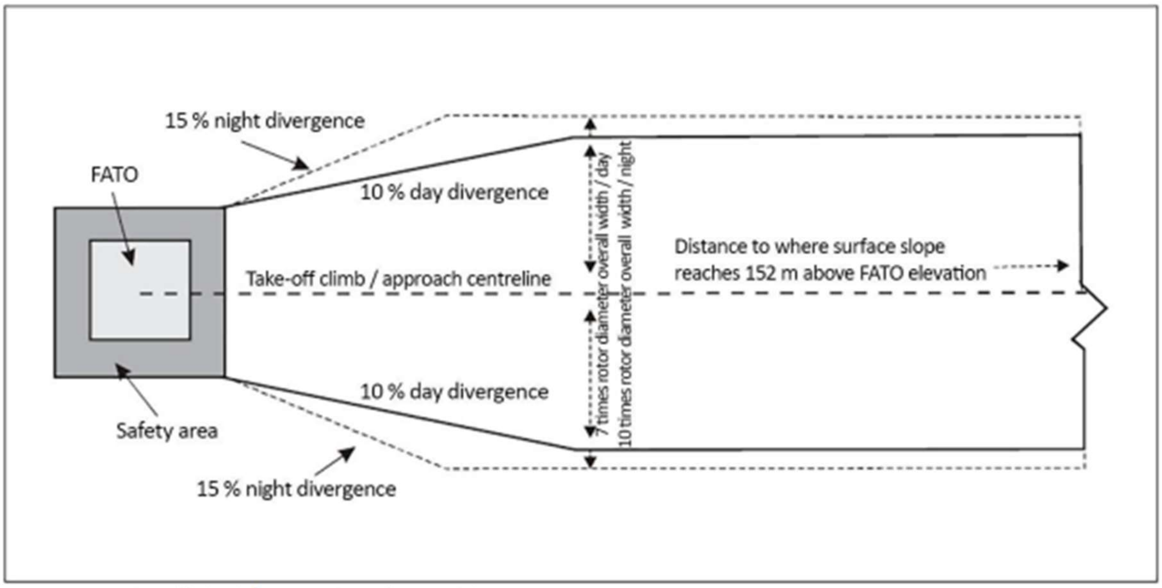


Figure 4.1 - Take-off climb/approach surface width.

SURFACE AND DIMENSIONS	SLOPE DESIGN CATEGORIES		
APPROACH AND TAKE OFF SURFACE:	**A**	**B**	**C**
Length of inner edge	Width of safety area	Width of safety area	Width of safety area
Location of inner edge	Safety area boundary (clearway boundary if provided)	Safety area boundary	Safety area boundary
Divergence: (1st and 2nd)section			
Day use only	10 %	10 %	10 %
Night use	15 %	15 %	15 %
First section			
Length	3 386 m	245 m	1 220 m
Slope	4.5 % (1:22.2)	8 % (1:12.5)	12.5% (1:8)
Outer width	(b)	N/A	(b)
Second section			
Lenght	N/A	830 m	N/A
Slope	N/A	16 % (1:6.25)	N/A
Outer width	N/A	(b)	N/A
Total length from inner edge	3 386 m	1 075 m	1 220 m
(a) The approach and take-off climb surface lengths of 3 386 m, 1075 m and 1220 m associated with the respective slopes, bring the VTOL-capable aircraft to 152 m (500 ft) above FATO elevation. **(b) Seven D-values overall width for day operations or ten D-values overall width for night operations.** **(c) This length may be reduced if vertical procedures are in place.** **(d) When the VTOL-capable aircraft procedure includes the lateral element, the transitional surface may be provided.**			
Note: The slope design categories depicted above represent minimum design slope angles and not operational slopes. Consultation with VTOL aircraft operators is needed to determine the appropriate slope category according to the vertiport environment and the VTOL aircraft the vertiport is intended to serve.			

Table 4.1 - Dimensions and slopes of obstacle limitation surfaces for all visual FATOs.

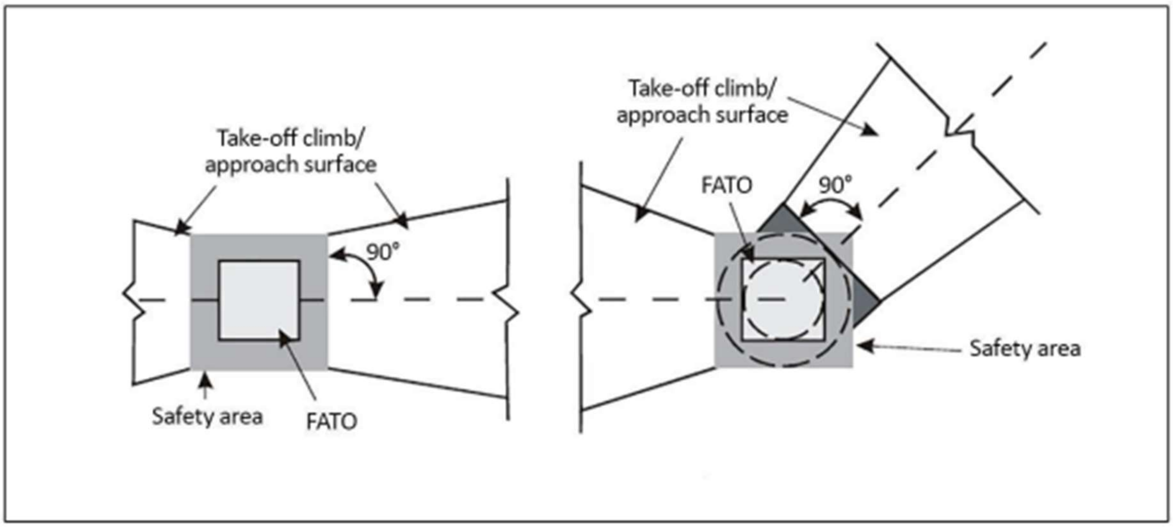


Figure 4.2 - Obstacle limitation surfaces — Take-off climb and approach surface

Note 1 - Dark grey shaded area requires the same characteristics as the safety area.

Note 2 - Angle between take-off climb/ approaches surfaces from centreline to centreline depicted for illustration purposes only.

Note 3 - Offset take-off climb/approach surface rotated around centre point of FATO.

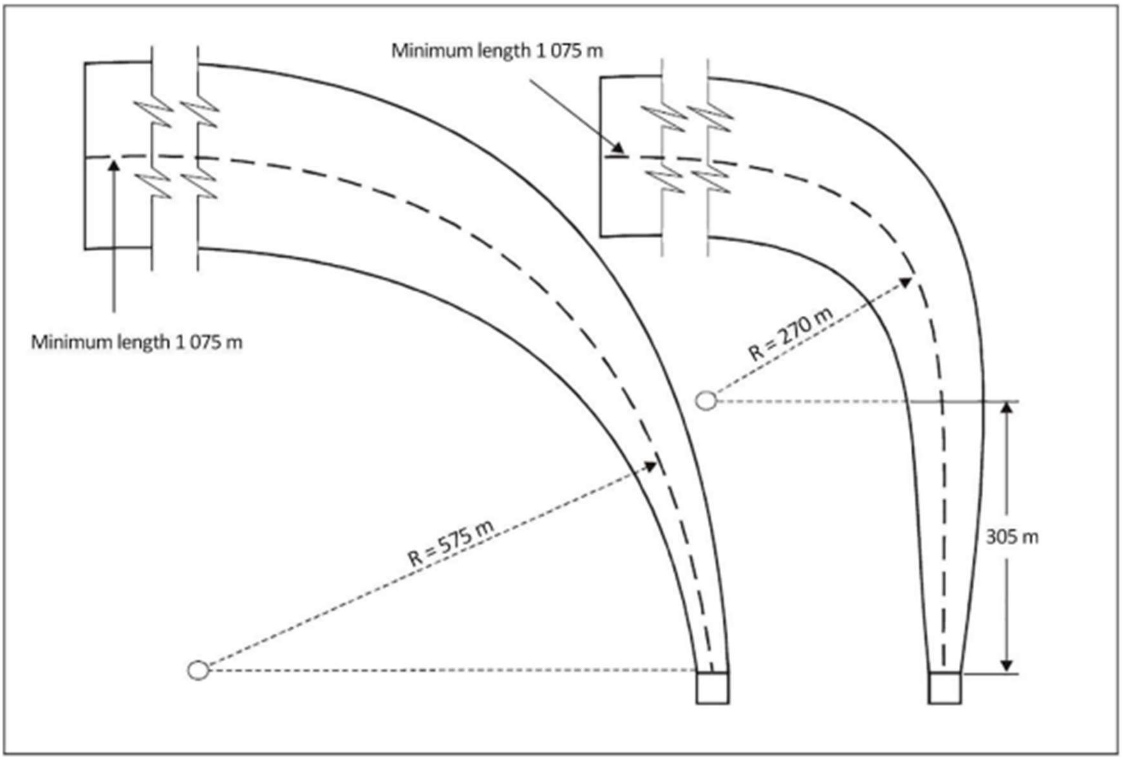


Figure 4.3 - Curved approach and take-off climb surface for all FATOs.

Note 1 - Any combination of curve and straight portion may be established using the following formula: S+R ≥ 575 m and R ≥ 270 m where S = 305 m, where S is the length of the straight portion and R is the radius of turn. Any combination ≥ 575 m will work.

Note 2 - The minimum length of the centre line of the curve and straight portion is 1075 m but may be longer depending upon the slope used. See table 13.2 for longer lengths.

Note 3 – VTOL aircraft take-off performance is expected to be reduced in a curve and as such a straight portion along the take-off climb surface prior to the start of the curve should be considered to allow for acceleration.

5. Visual Aids

5.1. General

5.1.1. When a FATO has similar characteristics to a runway, the applicable standards are provided in the paragraphs below entitled ‘runway-type FATO’.

5.1.2. For all other types of FATOs, the applicable standards are provided in the paragraphs below entitled ‘All FATOs except runway-type FATOs’.

5.1.3. When a runway is marked in accordance with the provisions of CAP 168, Chapter 7: Aerodrome signals, signs, and markings, and is utilised as a FATO, no additional runway markings or lighting are required for VTOL aircraft use.

5.2. Wind direction indicators

5.2.1. A vertiport should be equipped with at least one wind direction indicator.

5.2.2. If the wind direction indicators serving the aerodrome do not clearly indicate the correct wind information at the vertiport, additional wind direction indicator should be installed to provide wind information to the pilot during approach and take-off.

5.2.3. A wind direction indicator should be located to indicate the wind conditions over the FATO and TLOF and in such a way as to be free from the effects of airflow disturbances caused by nearby objects or rotor downwash and outwash. It should be visible from a VTOL aircraft in flight, in a hover and on the movement area.

5.2.4. Where a TLOF and/or FATO are subject to a disturbed airflow, additional wind direction indicators located close to the area should be provided to indicate the surface wind on the area.

5.2.5. The indicator should be sited to avoid the effects of turbulence and should be of sufficient size to be visible from VTOL aircraft flying at a height of 200 m. Where a TLOF may be subjected to a disturbed air flow, then additional small lightweight wind vanes located close to the area may prove useful.

5.2.6. A wind direction indicator should give a clear indication of the direction of the wind and a general indication of the wind speed.

5.2.7. A wind direction indicator for the vertiport should be a truncated cone made of lightweight fabric and should have the following minimum dimensions:

(a) Length: 2.4 m.

(b) Diameter: (larger end) 0.6 m, and

(c) Diameter: (smaller end) 0.3 m.

5.2.8. The colour of the wind direction indicator should be so selected as to make it clearly visible and understandable from a height of at least 200 m (650 ft) above the vertiport, having regard to the background:

(a) where practicable, a single colour, preferably white or orange, should be used;

(b) where a combination of two colours is required to be conspicuous against changing backgrounds, they should preferably be orange and white, red, and white, or black and white, and should be arranged in five alternate bands, the first and last band being the darker colour.

5.2.9. A wind direction indicator at a vertiport intended for use at night should be illuminated.

5.3. Vertiport identification marking

5.3.1. Vertiport identification markings should be provided at a vertiport.

5.3.2. For runway-type FATOs, a vertiport identification marking should be located in the FATO and when used in conjunction with FATO designation markings, should be displayed at each end of the FATO (see Figure 5.1).

5.3.3. For all FATOs except runway-type FATOs:

(a) A vertiport identification marking should be located at or near the centre of the FATO (see Figure 5.2).

(b) On a FATO which contains a TLOF, a vertiport identification marking should be located in the FATO so that the position of it coincides with the centre of the TLOF.

(c) On a FATO which does not contain a TLOF, and which is marked with an aiming point marking (see section 5.7), the vertiport identification marking should be established in the centre of the aiming point marking as shown in Figure 5.2.

5.3.4. A vertiport identification marking, except for a vertiport at a hospital, should consist of a letter 'V' in white inside a blue circle. The dimensions of the 'V' and the blue circle markings should be no less than those shown in Figure 5.3.

5.3.5. Where the 'V' marking is used for a runway-type FATO, its dimensions should be increased by a factor of 3 (see Figures 5.1 and 5.3).

5.3.6. A vertiport identification marking should be oriented with its symmetry axis aligned with the preferred final approach direction and so arranged as to be readable from the preferred final approach direction.

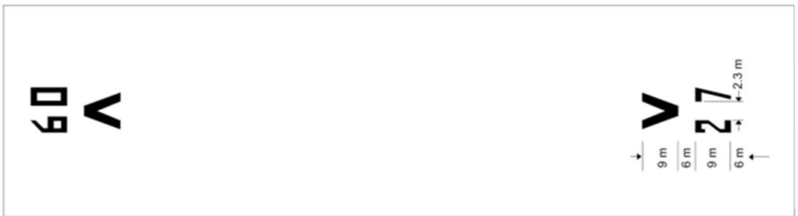


Figure 5.1- FATO designation marking and vertiport identification marking for a runway-type FATO (Illustration: EASA PTS-VPT-DSN).

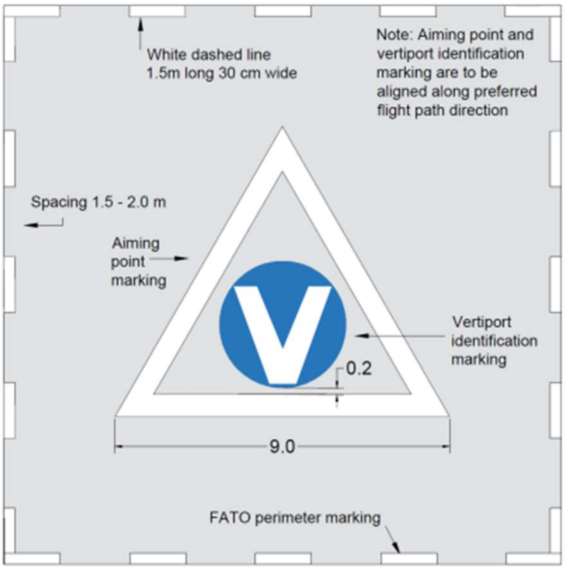


Figure 5.2 - Combined vertiport identification, aiming point and FATO perimeter marking (Illustration: EASA PTS-VPT-DSN).

Note: The aiming point, vertiport identification and FATO perimeter markings are white and may be edged with a 10 cm black border to improve contrast.

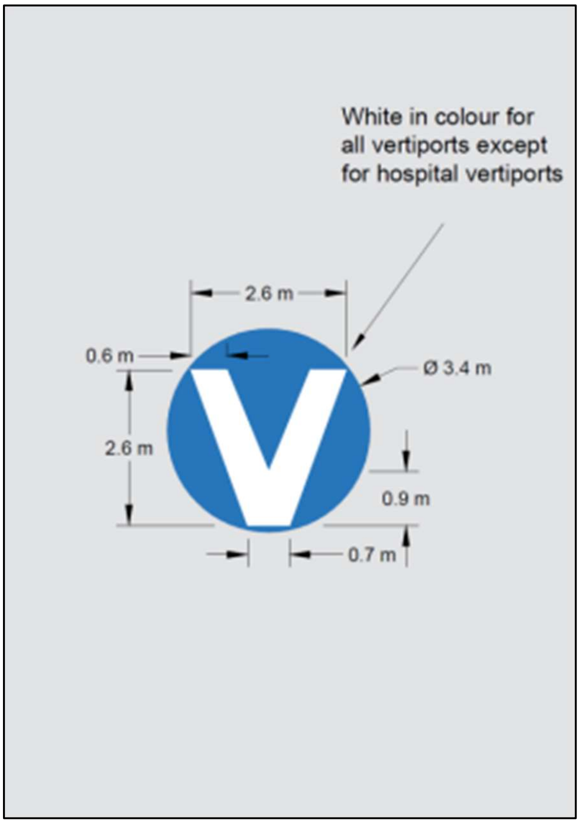


Figure 5.3 - Vertiport identification marking (Illustration: EASA PTS-VPT-DSN).

5.4. Final approach and take-off area identification markings

5.4.1. The objective of the FATO identification markings is to provide the pilot with an identification of different FATOs at vertiport equipped with two or more FATOs.

5.4.2. FATO identification markings are not intended to be used in runway-type FATOs where the differentiation can be provided by the designation markings.

5.4.3. Where appropriate for differentiation, FATO identification markings should be provided.

5.4.4. A FATO identification marking should be located within the FATO and so arranged to be readable from the preferred final approach direction.

5.4.5. Each FATO identification marking should consist of an ordinal number, beginning with 1 and ending in the last of the numbered FATOs (see Figure 5.4).

5.4.6. The numbers will have the size and proportions shown in Figure 5.6.

5.4.7. The FATO identification number will be inside a blue circle with diameter 175 cm as shown in Figure 5.4.

5.5. Final approach and take-off area perimeter marking or markers

5.5.1. FATO perimeter marking, or markers should be provided where the extent of the FATO is not self-evident.

5.5.2. The FATO perimeter marking, or markers should be located on the edge of the FATO.

5.5.3. For runway-type FATOs:

(a) The perimeter of the FATO should be defined with markings or markers spaced at equal intervals of not more than 50 m with at least three markings or markers on each side including a marking or marker at each corner.

(b) A FATO perimeter marking should be a rectangular stripe with a length of 9 m or one-fifth of the side of the FATO which it defines and a width of 1 m.

(c) FATO perimeter markings should be white.

(d) FATO perimeter markers should be of a colour (or colours) that contrasts (contrast) effectively against the operating background.

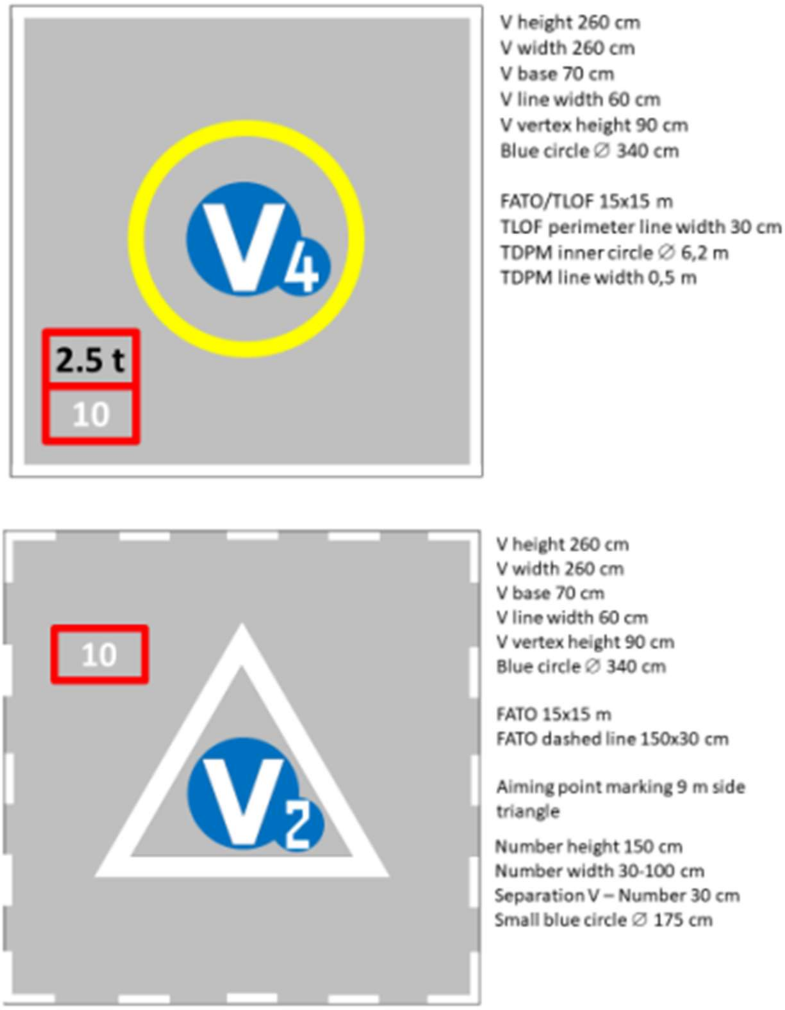


Figure 5.4 - Vertiport identification (multiple stands), FATO identification, maximum allowable mass and D-value (Illustration: EASA PTS-VPT-DSN).

5.5.4. For all FATOs except runway-type FATOs:

(a) For an unpaved FATO, the perimeter should be defined with flush in-ground markers. The FATO perimeter markers should be 30 cm in width, 1.5 m in length, and with end-to-end spacing of not less than

1.5 m and not more than 2 m. The corners of a square or rectangular FATO should be defined.

(b) For a paved FATO, the perimeter should be defined with a dashed line. The FATO perimeter marking segments should be 30 cm in width, 1.5 m in length, and with end-to-end spacing of not less than 1.5 m and not more than 2 m. The corners of the square or rectangular FATO should be defined.

(c) FATO perimeter markings and flush in-ground markers should be white.

5.5.5. Where a TLOF is coincident with a FATO, the TLOF marking can be used.

5.5.6. FATO perimeter markers should be of a single colour, either orange or red, or the two contrasting colours of orange and white or, alternatively, red and white should be used except where such colours would merge with the background. A FATO perimeter marker should have dimensional characteristics as shown in Figure 5.5.

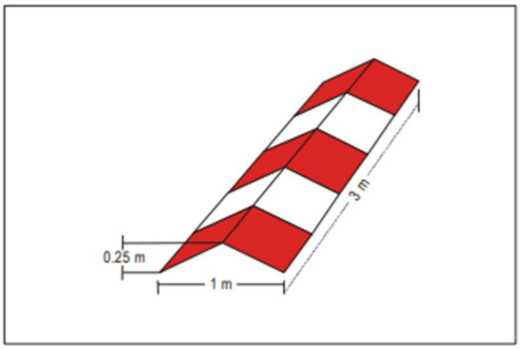


Figure 5.5 - Runway-type FATO edge marker

5.6. Final approach and take-off area designation marking

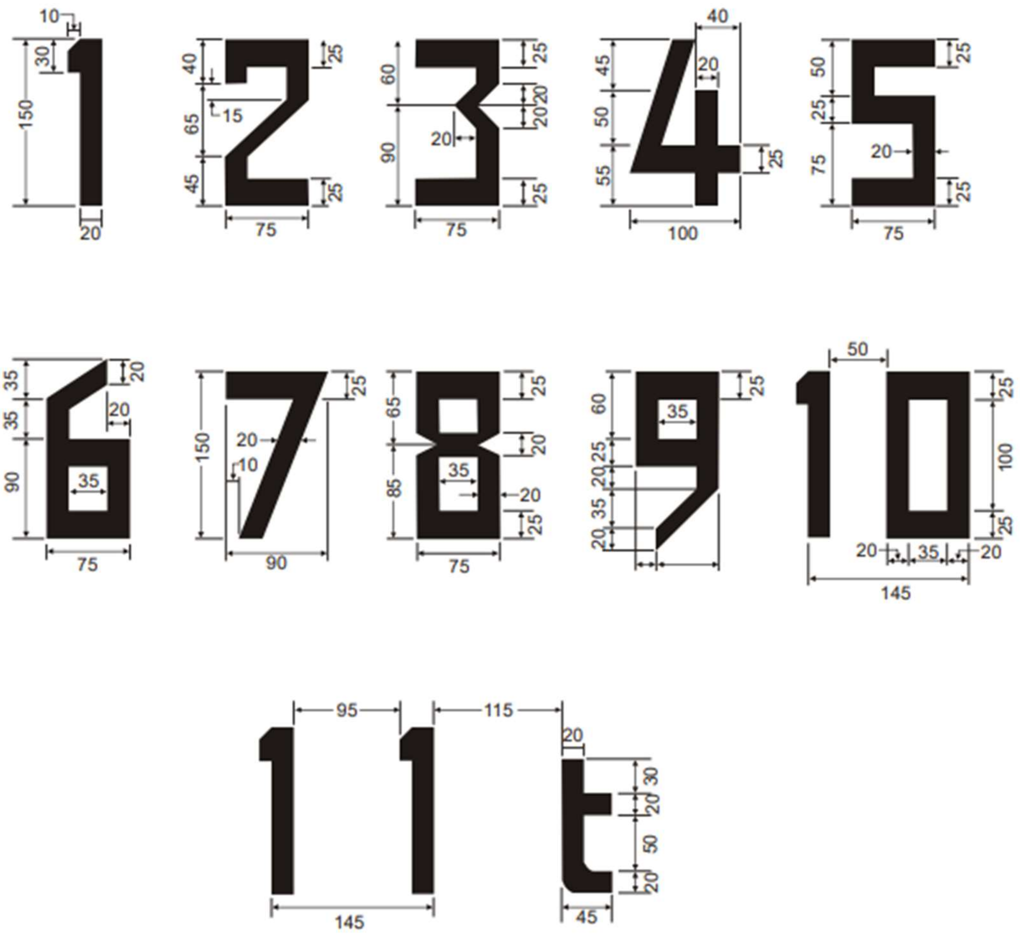
5.6.1. A FATO designation marking should be provided on a runway-type FATO at a vertiport where it is necessary to designate the FATO to the pilot.

5.6.2. Where provided, a FATO designation marking should be located at the beginning of the runway-type FATO (see Figure 5.1).

5.6.3. A FATO designation marking should consist of a two-digit number. The two-digit number should be the whole number nearest the one-tenth of the magnetic North when viewed from the direction of approach. When the above rule would give a single digit number, it should be preceded by a zero (see Figure 5.1).

5.6.4. The marking, as shown in Figure 5.1, should be supplemented by the vertiport identification marking ‘V’.

5.6.5. For a runway-type FATO, the numbers and the letter of the marking should have a white colour and should be in the form and proportion shown in Figure 5.6.



Note.— All units are expressed in centimetres.

Figure 5.6 - Form and proportions of numbers and letters

5.7. Aiming point marking

5.7.1. The safety objective of an aiming point marking is to provide a visual cue indicating to the pilot the preferred approach/departure direction, to the point to which the VTOL aircraft approaches to hover before positioning to a stand where a touchdown should be made, and that the surface of the FATO is not intended for touchdown.

5.7.2. An aiming point marking should be provided at a vertiport where it is necessary for a pilot to make an approach to a particular point above a FATO before proceeding to a TLOF.

5.7.3. Where provided, the aiming point marking should be located within the FATO (see Figure 5.2).

5.7.4. For all FATOs except runway-type FATOs, the aiming point marking should be located at the centre of the FATO, as shown in Figure 5.2.

5.7.5. The aiming point marking should be an equilateral triangle with a minimum side length of 9.0 metres, with the bisector of one of the angles aligned with the preferred approach direction.

5.7.6. The marking should consist of continuous white lines, 1.0 m in width (see Figures 5.2 and 5.16).

5.8. TLOF perimeter marking

5.8.1. The safety objective of the TLOF perimeter marking is to provide to the pilot a clear indication of a TLOF.

5.8.2. When the perimeter of the TLOF is not self-evident, a TLOF perimeter marking should be displayed on a TLOF located in a FATO.

5.8.3. Where provided, the TLOF perimeter marking should be located along the edge of the TLOF.

5.8.4. A TLOF perimeter marking should consist of a continuous white line with a width of at least 30 cm.

5.9. Touchdown positioning marking (TDPM)

5.9.1. A TDPM should be provided where it is necessary for a VTOL aircraft to touch down and/or be accurately positioned (see Figure 5.7).

5.9.2. A TDPM should be provided on a VTOL aircraft stand designed for turning.

5.9.3. A TDPM should be located so that when the pilot's seat is over the marking, the whole of the undercarriage should be within the TLOF, and all parts of the VTOL aircraft should be clear of any obstacle by a safe margin.

5.9.4. On a vertiport, the centre of the TDPM should be located at the centre of the TLOF, except the centre of the TDPM may be offset away from the centre of the TLOF where a safety assessment indicates such offsetting to be necessary, and providing that a marking that is so offset would not adversely affect safety.

5.9.5. For a VTOL aircraft stand designed for hover turning, the TDPM should be located in the centre of the central zone (see Figure 3.5).

5.9.6. A TDPM should be a yellow circle and have a line width of at least 0.5 m.

5.9.7. The inner diameter of the TDPM should be 0.5 D of the largest VTOL aircraft the TLOF and/or the VTOL aircraft stand is intended to serve.

5.10. Vertiport name marking

5.10.1. A vertiport name marking should be provided at a vertiport where there is insufficient alternative means of visual identification.

5.10.2. The vertiport name marking should be displayed on the vertiport so as to be visible, as far as practicable, at all angles above the horizontal.

5.10.3. A vertiport name marking should consist of the name or the alphanumeric designator of the vertiport as used in radio (R/T) communications.

5.10.4. A vertiport name marking intended for use at night or during conditions of poor visibility should be illuminated, either internally or externally.

5.10.5. The colour of the marking should contrast with the background and preferably be white.

5.10.6. Runway-type FATOs: The characters of the marking should be not less than 3 m in height.

5.10.7. All FATOs except runway-type FATOs: The characters of the marking should be not less than 1.5 m in height.

5.11. Vertiport ground taxiway markings and markers

5.11.1. The specifications for runway-holding position markings and for intermediate holding position marking defined in CAP 168, Chapter 7: Aerodrome signals, signs and markings are equally applicable to taxiways intended for ground taxiing of VTOL aircraft.

5.11.2. The centre line of a vertiport ground taxiway should be identified with a marking.

5.11.3. The edges of a vertiport ground taxiway, if not self-evident, should be identified with markers or markings.

5.11.4. Ground taxi-routes are not required to be marked.

5.11.5. Where necessary, signage should be provided on an aerodrome to indicate that a ground taxiway is suitable only for the use of VTOL aircraft.

5.11.6. A vertiport ground taxiway edge marker should not present a hazard for aircraft operations.

5.11.7. Vertiport ground taxiway markings should be along the centre line, and, if provided, along the edges of a vertiport ground taxiway.

5.11.8. Vertiport ground taxiway edge markers should be located at a distance of 0.5 m to 3 m beyond the edge of the vertiport ground taxiway.

5.11.9. Where provided, vertiport ground taxiway edge markers should be spaced at intervals of not more than 15 m on each side of straight sections and 7.5 m on each side of curved sections with a minimum of four equally spaced markers per section.

5.11.10. A vertiport ground taxiway centre line marking should be a continuous yellow line 15 cm in width.

5.11.11. Vertiport ground taxiway edge markings should be a continuous double yellow line, each 15 cm in width, and spaced 15 cm apart (nearest edge to nearest edge).

5.11.12. A vertiport ground taxiway edge marker should not exceed the height of a plane originating at a height of 25 cm above the plane of the vertiport ground taxiway, at a distance of 0.5 m from the edge of the vertiport ground taxiway and sloping upwards and outwards at a gradient of 5 percent to a distance of 3 m beyond the edge of the vertiport ground taxiway.

5.11.13. Vertiport ground taxiway edge markers should be frangible to the wheeled undercarriage of VTOL aircraft.

5.11.14. A vertiport ground taxiway edge marker should be blue.

5.11.15. If the vertiport ground taxiway is to be used at night, the edge markers should be internally illuminated or retro-reflective.

5.12. Vertiport air taxiway markings and markers

5.12.1. The specifications for runway-holding position markings and intermediate holding position marking defined in CAP 168, Chapter 7: Aerodrome signals, signs and markings are equally applicable to taxiways intended for air taxiing of VTOL aircraft.

5.12.2. The centre line of a vertiport air taxiway or, if not self-evident, the edges of a vertiport air taxiway, should be identified with markers or markings.

5.12.3. Vertiport air taxi-routes are not required to be marked.

5.12.4. Where a vertiport air taxiway could be confused with a vertiport ground taxiway, signage should be provided to indicate the mode of taxi operations that are permitted.

5.12.5. Vertiport air taxiway edge markers should not be located at a distance from the centre line of the vertiport air taxiway of less than 0.5 times the largest overall width of the VTOL aircraft for which it is designed.

5.12.6. Vertiport air taxiway edge markers should not penetrate a plane originating at a height of 25 cm above the plane of the vertiport air taxiway, at a distance from the centre line of the vertiport air taxiway of 0.5 times the largest overall width of the VTOL aircraft for which it is designed and sloping upwards and outwards at a gradient of 5 percent.

5.12.7. A vertiport air taxiway centre line marking, or flush in-ground centre line marker should be located along the centre line of the vertiport air taxiway.

5.12.8. Vertiport air taxiway edge markings should be located along the edges of a vertiport air taxiway.

5.12.9. Vertiport air taxiway edge markers should be located at a distance of 1 m to 3 m beyond the edge of the vertiport air taxiway.

5.12.10. A vertiport air taxiway centre line should be marked with a continuous yellow line 15 cm in width, when on a paved surface.

5.12.11. The edges of a vertiport air taxiway, when on a paved surface, should be marked with continuous double yellow lines each 15 cm in width, and spaced 15 cm apart (nearest edge to nearest edge).

5.12.12. Where a vertiport air taxiway is located on an unpaved surface and painted markings of a vertiport air taxiway centre line cannot be provided, it should be marked with flush inground 15 cm wide and approximately 1.5 m in length yellow markers, spaced at intervals of not more than 30 m on straight sections and not more than 15 m on curves, with a minimum of four equally spaced markers per section.

5.12.13. Vertiport air taxiway edge markers, where provided, should be spaced at intervals of not more than 30 m on each side of straight sections and not more than 15 m on each side of curves, with a minimum of four equally spaced markers per section.

5.12.14. Vertiport air taxiway edge markers should be frangible.

5.12.15. Vertiport air taxiway edge markers should not penetrate a plane originating at a height of 25 cm above the plane of the vertiport air taxiway, at a distance of 1 m from the edge of the vertiport air taxiway and sloping upwards and outwards at a gradient of 5 percent to a distance of 3 m beyond the edge of the vertiport air taxiway.

5.12.16. A vertiport air taxiway edge marker should be of a colour (or colours) that contrasts (contrast) effectively against the operating background. The red colour should not be used for markers.

5.12.17. If the vertiport air taxiway is to be used at night, vertiport air taxiway edge markers should be either internally illuminated or retro-reflective.

5.13. Vertiport stand markings

5.13.1. A vertiport stand perimeter marking should be provided on a VTOL aircraft stand designed for turning. If a VTOL aircraft stand perimeter marking is not practicable, a central zone perimeter marking should be provided instead if the perimeter of the central zone is not self-evident.

5.13.2. A vertiport stand should be provided with the appropriate TDPM, see Figure 5.7.

5.13.3. Where the stand is designed to accommodate VTOL aircraft with a D smaller than the Design-D, the limiting D-value should be displayed on the lead-in line. The maximum allowable mass may be added if required (see Figure 5.7).

5.13.4. For a vertiport stand that is intended to be used for taxi-through and which does not allow a VTOL aircraft to turn, a stop line should be provided.

5.13.5. Alignment lines and lead-in/lead-out lines should be provided on a VTOL aircraft stand (see Figure 5.7).

5.13.6. Vertiport stand identification markings should be provided where there is a need to identify individual stands.

5.13.7. A vertiport stand perimeter marking on a vertiport stand designed for turning or, a central zone perimeter marking, should be concentric with the central zone of the stand.

5.13.8. For a vertiport stand that is intended to be used for taxi-through and which does not allow the VTOL aircraft to turn, a stop line should be located on the vertiport ground taxiway axis at right angles to the centre line.

5.13.9. The TDPM, alignment lines and lead-in/lead-out lines should be located such that every part of the VTOL aircraft can be contained within the vertiport stand during positioning and permitted manoeuvring.

5.13.10. A vertiport stand perimeter marking should be a yellow circle and have a line width of 15 cm.

5.13.11. A central zone perimeter marking should be a yellow circle and have a line width of 15 cm, except when the TLOF is collocated with a vertiport stand, in which case the characteristics of the TLOF perimeter markings should apply.

5.13.12. For a vertiport stand that is intended to be used for taxi-through and which does not allow the VTOL aircraft to turn, the yellow stop line should not be less than the width of the vertiport ground taxiway and should have a line thickness of 50 cm.

5.13.13. Alignment lines and lead-in/lead-out lines should be continuous yellow lines and should have a width of 15 cm.

5.13.14. Curved portions of alignment lines and lead-in/lead-out lines should have radii appropriate to the most demanding VTOL aircraft the vertiport stand is intended to serve.

5.13.15. Stand identification markings should be marked in a contrasting colour so as to be easily readable.

5.13.16. Where it is intended that VTOL aircraft proceed in one direction only, arrows indicating the direction to be followed may be added as part of the alignment lines.

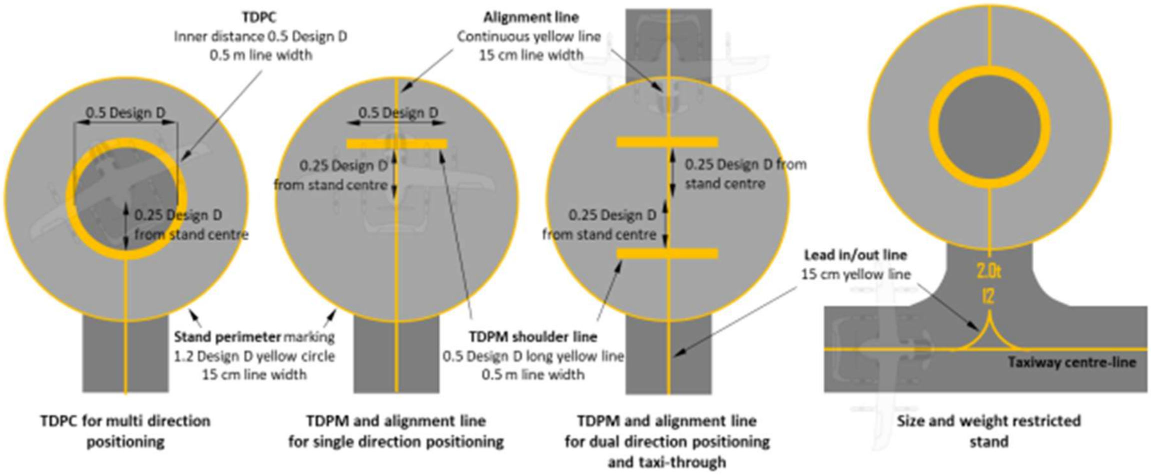


Figure 5.7 - Vertiport stand markings (Illustration: CASA).

5.14. Flight path alignment guidance marking

5.14.1. Where provided at a vertiport, a flight path alignment guidance marking (or markings) should indicate the available approach and/or departure path direction(s).

5.14.2. The flight path alignment guidance marking should be located in a straight line along the direction of approach and/or departure path on one or more of the TLOF, FATO, safety area or any suitable surface in the immediate vicinity of the FATO or the safety area.

5.14.3. A flight path alignment guidance marking should consist of one or more arrows marked on the TLOF, FATO and/or safety area surface, as shown in Figure 5.8. The stroke of the arrow(s)should be 50 cm in width and at least 3 m in length. When combined with a flight path alignment guidance lighting system, it should take the form shown in Figure F-6, which includes the scheme for marking the 'heads of the arrows', which are always of the same size, regardless of the stroke length.

5.14.4. In the case of a flight path limited to a single approach direction or a single departure direction, the arrow marking may be unidirectional. In the case of a vertiport with only a single approach/departure path available, one bidirectional arrow is marked.

5.14.5. The markings should be in a colour, preferably white, which provides good contrast against the background colour of the surface on which they are marked.

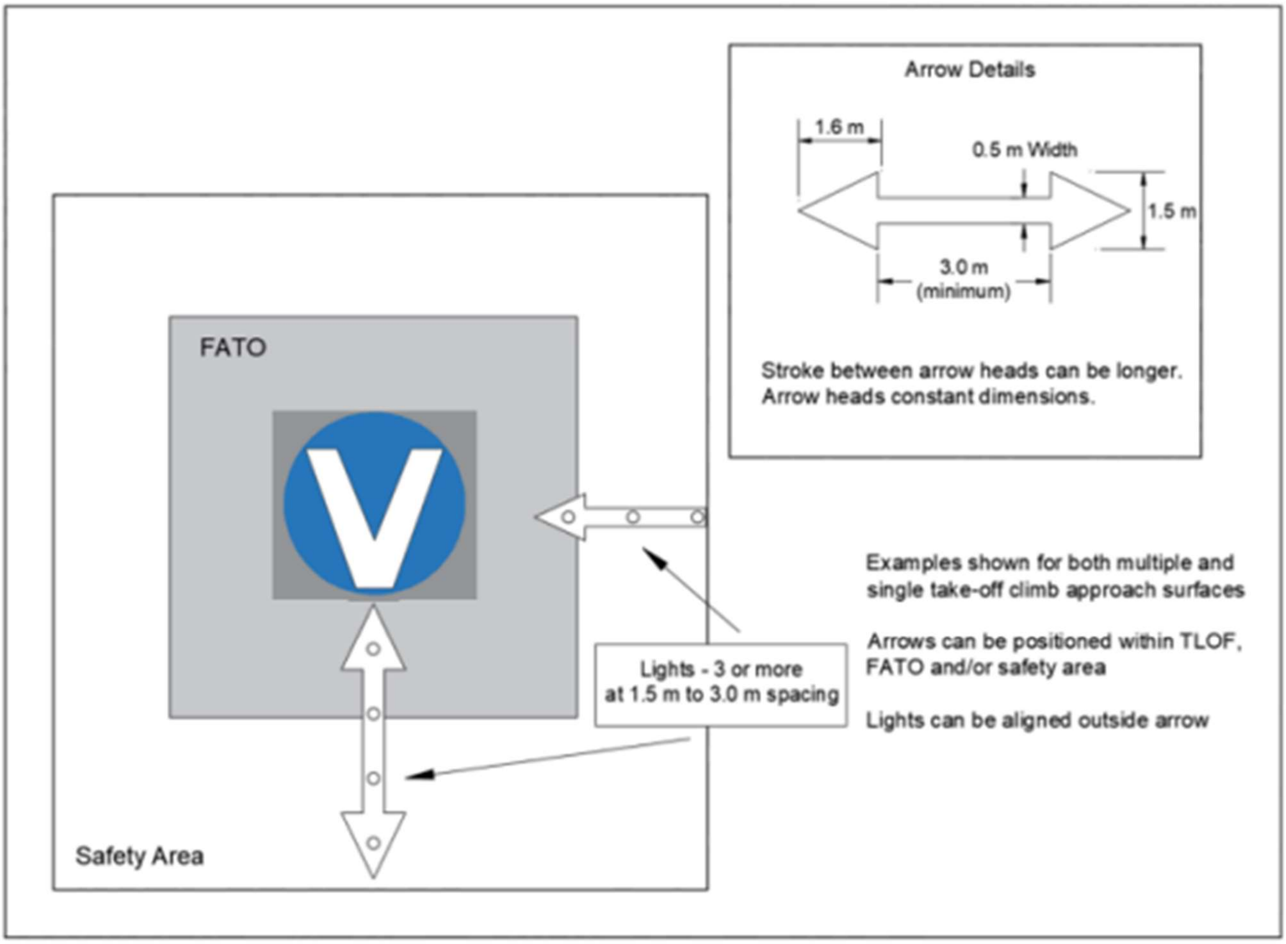


Figure 5.8 - Flight path alignment guidance markings and lights (Illustration: EASA PTS-VPT-DSN).

5.15. Approach lighting system

5.15.1. Where provided at a vertiport, an approach lighting system should indicate a preferred approach direction.

5.15.2. The approach lighting system should be located in a straight line along the preferred direction of approach.

5.15.3. An approach lighting system should consist of a row of three lights spaced uniformly at 30 m intervals and of a crossbar 18 m in length at a distance of 90 m from the perimeter of the FATO as shown in Figure 5.9. The lights forming the crossbar should be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights, and spaced at 4.5 m intervals.

5.15.4. Where there is a need to make the final approach course more conspicuous, additional lights spaced uniformly at 30 m intervals should be added beyond the crossbar. The lights beyond the crossbar may be steady or sequenced flashing, depending upon the environment.

5.15.5. The steady lights should be omnidirectional white lights.

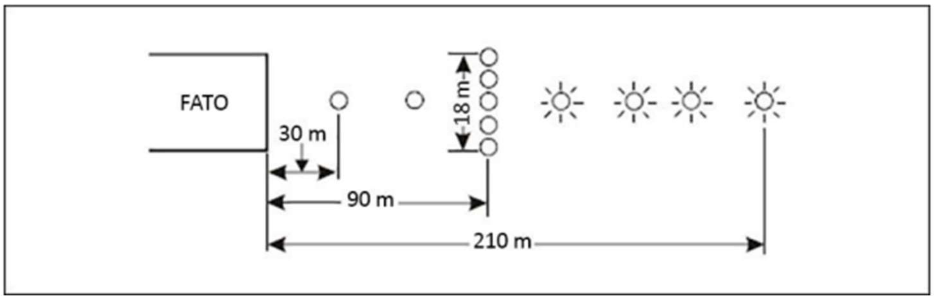


Figure 5.9 - Approach lighting system

5.15.6. Sequenced flashing lights should be omnidirectional white lights.

5.15.7. The flashing lights should have a flash frequency of one per second and their light distribution should be as shown in Figure 5.10, Illustration 2. The flash sequence should commence from the outermost light and progress towards the crossbar.

5.15.8. A suitable brilliancy control should be incorporated to allow for adjustment of light intensity to meet the prevailing conditions.

5.15.9. Additional guidance on light intensity controls is given in CAP 168, Chapter 6: Aeronautical Ground Lighting.

5.16. Flight path alignment guidance lighting system

5.16.1. Where provided at a vertiport, a flight path alignment guidance lighting system (or systems) should indicate the available approach and/or departure path direction(s).

5.16.2. The flight path alignment guidance lighting can be combined with a flight path alignment guidance marking (or markings).

5.16.3. The flight path alignment guidance lighting system should be in a straight line along the direction(s) of approach and/or departure path on one or more of the TLOF, FATO, safety area or any suitable surface in the immediate vicinity of the FATO, TLOF or safety area.

5.16.4. If combined with a flight path alignment guidance marking, then as far as is practicable, the lights should be located inside the ‘arrow’ markings.

5.16.5. A flight path alignment guidance lighting system should consist of a row of three or more lights spaced uniformly over a total minimum distance of 6 m. Intervals between lights should not be less than 1.5 m and should not exceed 3 m.

5.16.6. Where space permits, there should be 5 lights. The number of lights and the spacing between these lights may be adjusted to reflect the space available.

5.16.7. If more than one flight path alignment system is used to indicate the available approach and/or departure path direction(s), the characteristics for each system are typically kept the same (see Figure 5.9).

5.16.8. The lights should be steady omnidirectional inset white lights.

5.16.9. The distribution of the lights should be as indicated in Figure 5.10, Illustration 5.

5.16.10. A suitable control should be incorporated to allow for adjustment of light intensity to meet the prevailing conditions and to balance the flight path alignment guidance lighting system with other vertiport lights and general lighting that may be present around the vertiport.

5.17. Visual alignment guidance system

5.17.1. Where provided at a vertiport, a visual alignment guidance system should provide guidance to the pilot during the approach to a vertiport.

5.17.2. A visual alignment guidance system should be provided where one or more of the following conditions exist:

(a) obstacle clearance, noise abatement or traffic control procedures require a particular direction to be flown.

(b) the environment of the vertiport provides few visual surface cues.

(c) it is physically impracticable to install an approach lighting system.

5.17.3. The visual alignment guidance system should be located such that a VTOL aircraft is guided along the prescribed track towards the FATO.

5.17.4. The system should be located at the downwind edge of the FATO and aligned along the preferred approach direction.

5.17.5. The light units should be frangible and mounted as low as possible.

5.17.6. Where the lights of the system need to be seen as discrete sources, light units should be located such that at the extremes of system coverage, the angle subtended between the units as seen by the pilot should not be less than 3 minutes of arc.

5.17.7. The angles subtended between the light units of the system and other units of comparable or greater intensities should also be not less than 3 minutes of arc.

5.17.8. The requirements of paragraphs 5.17.4 and 5.17.5 above can be met for lights on a line normal to the line of sight if the light units are separated by 1 m for every kilometre of viewing range.

5.17.9. Signal format:

(a) The signal format of the alignment guidance system should include a minimum of three discrete signal sectors providing ‘offset to the right’, ‘on track’ and ‘offset to the left’ signals.

(b) The divergence of the ‘on track’ sector of the system should be 1° as shown in Figure 5.11.

(c) The signal format should be such that there is no possibility of confusion between the system and any associated visual approach slope indicator or other visual aids.

(d) The system should avoid the use of the same coding as any associated visual approach slope indicator.

(e) The signal format should be such that the system is unique and conspicuous in all operational environments.

(f) The system should not significantly increase the pilot workload.

5.17.10. Light distribution:

(a) The usable coverage of the visual alignment guidance system should be equal to or better than that of the visual approach slope indicator system with which it is associated.

(b) A suitable intensity control should be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

(c) Approach track and azimuth setting:

(d) A visual alignment guidance system should be capable of adjustment in azimuth to within ± 5 minutes of arc of the desired approach path.

(e) The angle of the azimuth guidance system should be such that during an approach, the pilot of a VTOL aircraft at the boundary of the ‘on track’ signal would clear all objects in the approach area by a safe margin.

(f) The characteristics of the obstacle protection surface specified in section 5.18, Table 5.1 and Figure 5.12 should equally apply to the system.

5.17.11. Characteristics of the visual alignment guidance system:

(a) In the event of a failure of any component affecting the signal format, the system should be automatically switched off.

(b) The light units should be so designed that deposits such as condensation, ice, and dirt for example on optically transmitting or reflecting surfaces would interfere to the least possible extent with the light signal and should not cause spurious or false signals to be generated.

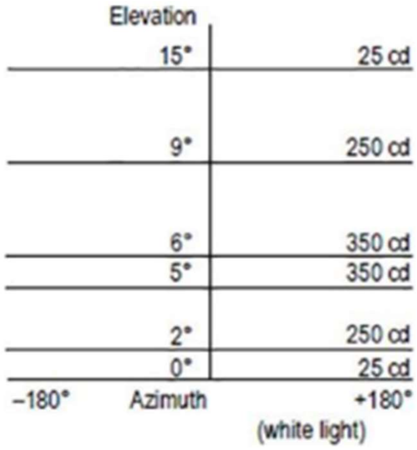


Illustration 1 – Approach light steady burning

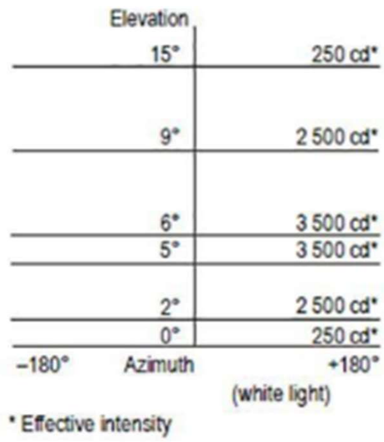


Illustration 2 – Approach light flashing

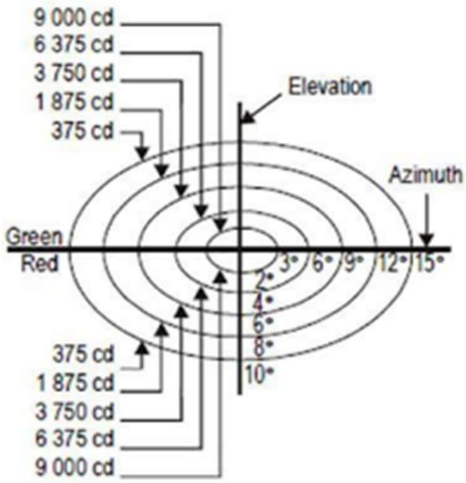


Illustration 3 – HAPI system

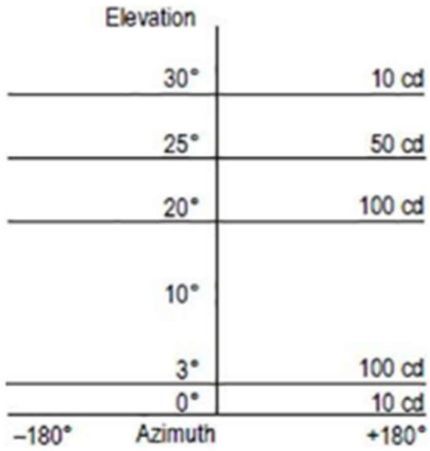
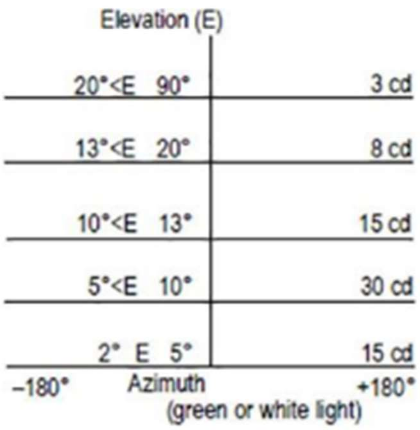


Illustration 4 – Final approach and take-off lights and aiming point lights



Note – Additional values may be required in the case of installations requiring identification by means of the lights at an elevation of less than two degrees.

Illustration 5 – TLOF perimeter lights and flight path alignment guidance lighting system

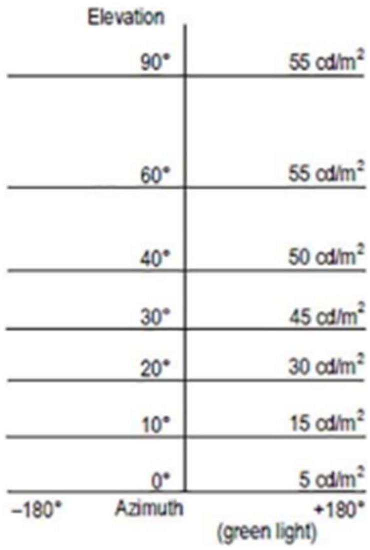


Illustration 6 – Touchdown and lift-off area luminescent panels

Figure 5.10 - Isocandela diagram

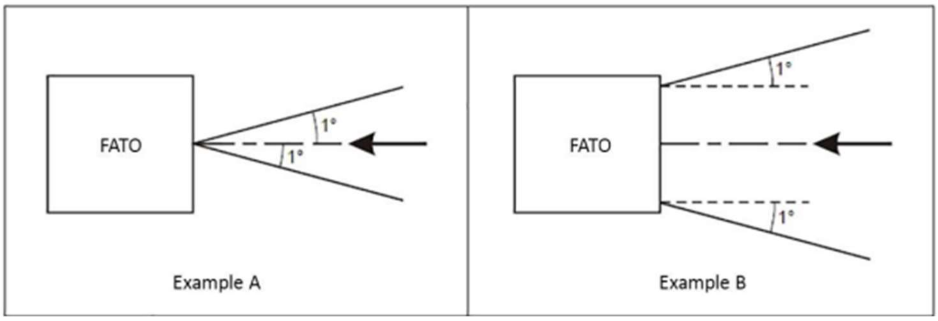


Figure 5.11 - Divergence of the 'on track' sector.

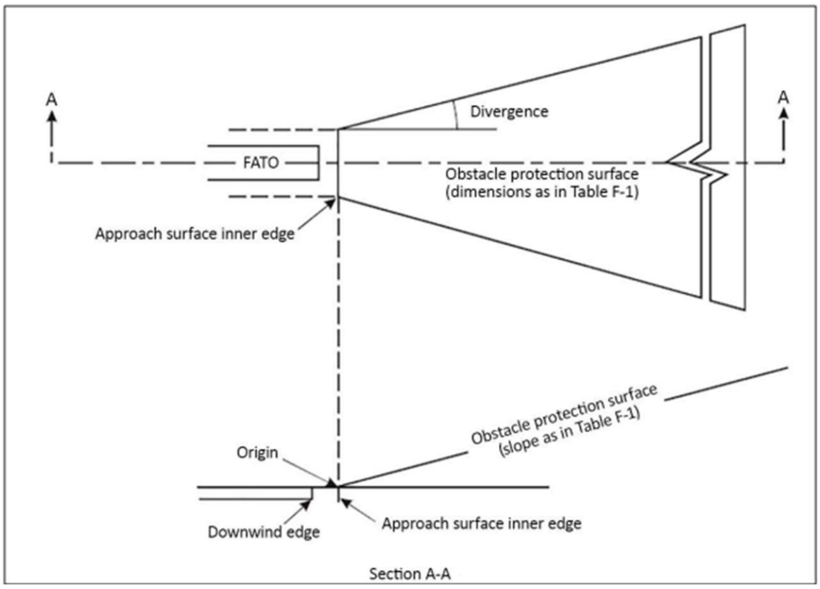


Figure 5.12 - Obstacle protection surface for visual approach slope indicator systems.

Surface and Dimension	FATO	
Length of inner edge	Width of safety area	
Distance from edge of FATO	3 m minimum	
Divergence	10 percent	
Total length	2500 m	
Slope	PAPI	Aa – 0.57°
	HAPI	Ab – 0.65°
	APAPI	Aa – 0-9°

a. As indicated in CAP 168 Chapter 6: Aeronautical Ground Lighting

b. The angle of the upper boundary of the 'below slope' signal

Table 5.1 - Dimensions and slopes of the obstacle protection surface for vertiport visual approach indicator system.

5.18. Visual approach slope indicator

5.18.1. Where provided at a vertiport, a visual slope indicator system should provide information on the approach angle necessary to maintain a safe height over obstacles on the approach to a vertiport.

5.18.2. A visual approach slope indicator should be provided for a vertiport where one or more of the following conditions exist:

(a) obstacle clearance, noise abatement or traffic control procedures require a particular slope to be flown;

(b) the environment of the vertiport provides few visual surface cues; and

(c) the characteristics of the VTOL aircraft require a stabilised approach.

5.18.3. When more than one visual approach slope indicator is installed at an aerodrome, for example precision approach path indicator (PAPI) or abbreviated precision approach path indicator (APAPI) systems, a visual approach slope indicator should be designed and calibrated to give a clear and unambiguous indication to VTOL aircraft pilots approaching to land.

5.18.4. A vertiport visual approach slope indicator should be located adjacent to the nominal aiming point and aligned in azimuth with the preferred approach direction.

5.18.5. Care should be taken in the design of the unit to minimise spurious signals between the signal sectors, and at the azimuth coverage limits.

5.18.6. Larger azimuth coverage can be obtained by installing the HAPI (Helicopter Approach Path Indicator) system on a turntable.

5.18.7. The standard visual approach slope indicator systems for VTOL aircraft operations should consist of the following:

(a) PAPI and APAPI systems conforming to the specifications contained in CAP 168, chapter 6 PAPI Siting and setting angles, except that the angular size of the on-slope sector of the systems should be increased to 45 minutes of arc; or

(b) HAPI system conforming to the specifications in paragraphs 5.18.8 to 5.18.18 below.

5.18.8. A visual approach slope indicator should be located such that a VTOL aircraft is guided to the desired position within the FATO and to avoid dazzling the pilot during final approach and landing.

5.18.9. The light unit(s) should be mounted as low as possible.

5.18.10. Characteristics of the HAPI signal format:

(a) The signal format of the HAPI should include four discrete signal sectors, providing an ‘above slope’, an ‘on slope’, a ‘slightly below’ and a ‘below slope’ signal.

(b) The signal format of the HAPI should be as shown in Figure 5.13, Illustrations A and B.

(c) The signal repetition rate of the flashing sector of the HAPI should be at least 2 Hz.

(d) The on-to-off ratio of pulsing signals of the HAPI should be 1 to 1, and the modulation depth should be at least 80 percent.

(e) The angular size of the ‘on-slope’ sector of the HAPI should be 45 minutes of arc.

(f) The angular size of the ‘slightly below’ sector of the HAPI should be 15 minutes of arc.

5.18.11. Light distribution:

(a) The light intensity distribution of the HAPI in red and green colours should be as shown in Figure 5.10, Illustration 3.

(b) The colour transition of the HAPI in the vertical plane should be such as to appear to an observer at a distance of not less than 300 m to occur within a vertical angle of not more than three minutes of arc.

(c) The transmission factor of a red or green filter should be not less than 15 percent at the maximum intensity setting.

(d) At full intensity, the red light of the HAPI should have a Y-coordinate not exceeding 0.320, and the green light should be within the boundaries specified in CAP 168, Annex 6A, paragraph 40.

(e) A suitable intensity control should be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

Sector	Format
Above	Flashing green
On slope	Green
Slightly below	Red
Below	Flashing red

Illustration A

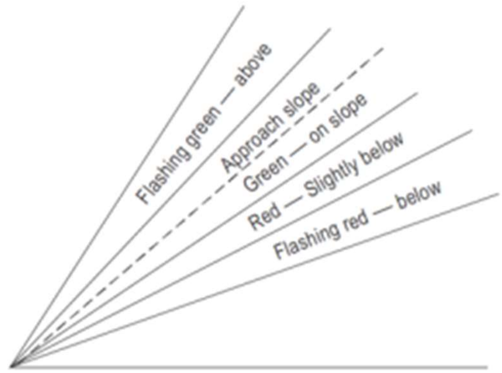


Illustration B

Figure 5.13 - HAPI signal format.

5.18.12. Approach slope and elevation setting:

(a) A HAPI system should be capable of adjustment in elevation at any desired angle between 1 degree and 12 degrees above the horizontal with an accuracy of ± 5 minutes of arc.

(b) The angle of elevation setting of a HAPI should be such that during an approach, the pilot of a VTOL aircraft observing the upper boundary of the 'below slope' signal would clear all objects in the approach area by a safe margin.

(c) The light unit system should be so designed that:

(d) in the event the vertical misalignment of a unit exceeds ± 0.5 degrees (± 30 minutes), the system should switch off automatically; and

(e) if the flashing mechanism fails, no light is emitted in the failed flashing sector(s).

5.18.13. The light unit of the HAPI should be so designed that deposits such as condensation, ice, and dirt for example on optically transmitting or reflecting surfaces would interfere to the least possible extent with the light signal and should not cause spurious or false signals to be generated.

5.18.14. An obstacle protection surface should be established when it is intended to provide a visual approach slope indicator system.

5.18.15. The characteristics of the obstacle protection surface such as origin, divergence, length, and slope for example, should correspond to those specified in the relevant column of Table 5.3 and in Figure 5.12.

5.18.16. New objects or extensions of existing objects should not be permitted above an obstacle protection surface except when the new object or extension would be shielded by an existing immovable object.

5.18.17. Existing objects above an obstacle protection surface should be removed except when the object is shielded by an existing immovable object, or when after a safety assessment, it is determined that the object would not adversely affect the safety of operations of VTOL aircraft.

5.18.18. Where a safety assessment indicates that an existing object extending above an obstacle protection surface could adversely affect the safety of operations of VTOL aircraft, one or more of the following measures should be taken:

(a) suitably raise the approach slope of the system;

(b) reduce the azimuth spread of the system so that the object is outside the confines of the beam;

(c) displace the axis of the system and its associated obstacle protection surface by no more than 5 degrees;

(d) suitably displace the FATO; and

(e) install a visual alignment guidance system.

5.19. FATO lighting systems

5.19.1. FATO lights should be provided where a FATO is established at a vertiport intended for use at night. They can be omitted where the FATO and the TLOF are nearly coincidental and the TLOF lights are provided, or the extent of the FATO is self-evident.

5.19.2. FATO lights should be placed along the edges of the FATO. The lights should be uniformly spaced as follows:

(a) for an area in the form of a square or rectangle, at intervals of not more than 50 m with a minimum of four lights on each side including a light at each corner (see Figure 5.14); and

(b) for any other shaped area, including a circular area, at intervals of not more than 5 m with a minimum of ten lights.

(c) FATO lights should be fixed omnidirectional lights showing white. Where the intensity of the lights is to be varied, the lights should show variable white.

(d) The light distribution of FATO lights should be as shown in Figure 5.10, Illustration 4.

(e) The lights should not exceed a height of 25 cm and should be inset when a light extending above the surface would endanger VTOL aircraft operations.

(f) Where a FATO is not meant for lift-off or touchdown, the lights should not exceed a height of 25 cm above ground or snow level.

5.20. Aiming point lights

5.20.1. Aiming point lights should be provided where an aiming point marking is provided at a vertiport intended for use at night.

5.20.2. Aiming point lights should be collocated with the aiming point marking.

5.20.3. Aiming point lights should form a pattern of at least six omnidirectional white lights (see Figure 5.15).

5.20.4. The lights should be inset when a light extending above the surface could endanger VTOL aircraft operations.

5.20.5. The light distribution of aiming point lights should be as shown in Figure 5.10, Illustration 4.

Figure 5.14 - Lighting system for FATO at surface level (Illustration: EASA PTS-VPT-DSN).

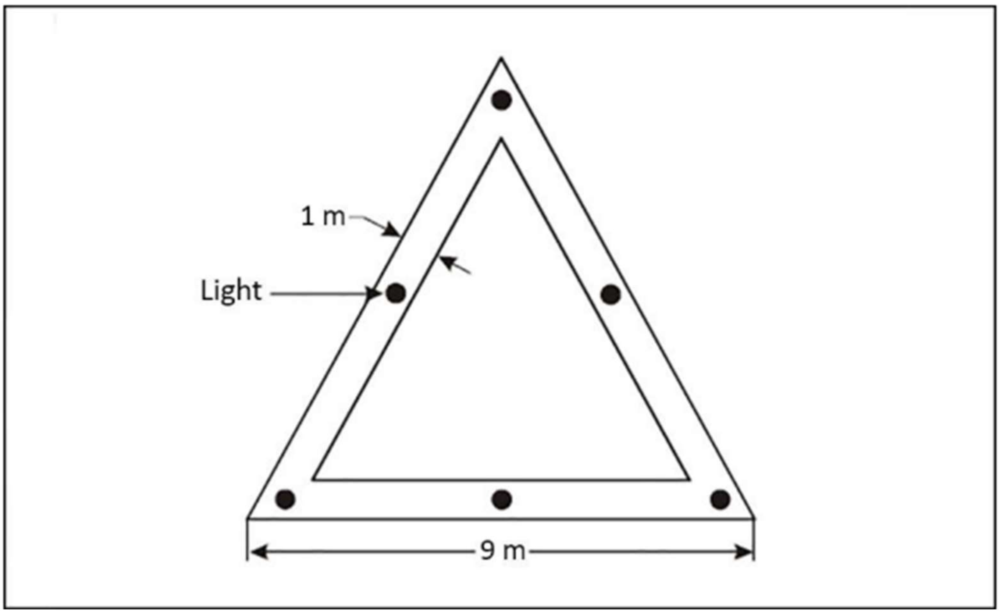


Figure 5.15 - Aiming point marking and lighting.

5.21. TLOF lighting system

5.21.1. A TLOF lighting system should be provided at a vertiport intended for use at night.

5.21.2. The TLOF lighting system for a vertiport should consist of one or more of the following:

(a) perimeter lights; or

(b) floodlighting (See Figure 5.16); or

(c) ASPSL or LP lighting to identify the TLOF when 1. and 2. are not practicable and FATO lights are available.

5.21.3. TLOF ASPSL and/or LPs to identify the touchdown marking and/or floodlighting should be provided for use at night when enhanced surface texture cues are recommended.

5.21.4. TLOF perimeter lights should be placed along the edge of the area designated for use as the TLOF or within a distance of 1.5 m from the edge.

5.21.5. Where the TLOF is a circle, the lights should be:

(a) located on straight lines in a pattern which should provide information to pilots on drift displacement; or

(b) evenly spaced around the perimeter of the TLOF at the appropriate intervals, sufficient to present the pattern, except that over a sector of 45 degrees, the lights should be spaced at half spacing.

5.21.6. TLOF perimeter lights should be uniformly spaced at intervals of not more than 5 m.

5.21.7. Where TLOF perimeter lights are located on straight lines, there should be a minimum number of four lights on each side, including a light at each corner.

5.21.8. For a circular TLOF, where lights are installed in accordance with paragraph 5.21.2 (a) above, there should be a minimum of fourteen lights evenly placed around the perimeter of the area.

5.21.9. Where ASPSL or LPs are provided to identify the TLOF, which is not a circle, they should be placed along the marking designating the edge of the TLOF.

5.21.10. Where ASPL or LPs are provided to identify the TLOF, which is a circle, they should be located on straight lines circumscribing the area.

5.21.11. The minimum number of LPs on a TLOF should be nine.

5.21.12. The total length of LPs in a pattern should not be less than 50 percent of the length of the pattern.

5.21.13. There should be an odd number of LPs with a minimum number of three panels on each side of the TLOF, including a panel at each corner.

5.21.14. LPs should be uniformly spaced with a distance between adjacent panel ends of not more than 5 m on each side of the TLOF.

5.21.15. TLOF floodlights should be located so as to avoid glare to pilots in flight or to personnel working on the area.

5.21.16. The arrangement and aiming of floodlights should be such that shadows are kept to a minimum.

5.21.17. The TLOF perimeter lights should be fixed omnidirectional lights showing green.

5.21.18. ASPSL or LPs should emit green light when used to define the perimeter of the TLOF.

5.21.19. The chromaticity and luminance of colours of LPs should be in accordance with the specifications in CAP 168, Appendix 6A: Aeronautical ground lighting characteristics.

5.21.20. An LP should have a minimum width of 6 cm. The panel housing should be the same colour as the marking it defines.

5.21.21. The perimeter lights should not exceed a height of 25 cm and should be inset when a light extending above the surface could endanger VTOL aircraft operations.

5.21.22. When located within the safety area of a vertiport, the TLOF floodlights should not exceed a height of 25 cm.

5.21.23. The LPs should not extend above the surface by more than 2.5 cm.

5.21.24. The lighting used to identify the touchdown marking should comprise a segmented circle of omnidirectional ASPSL strips showing yellow. The segments should consist of ASPSL strips, and the total length of the ASPSL strips should not be less than 50 percent of the circumference of the circle.

5.21.25. If utilised, the vertiport identification marking lighting should be omnidirectional showing green.

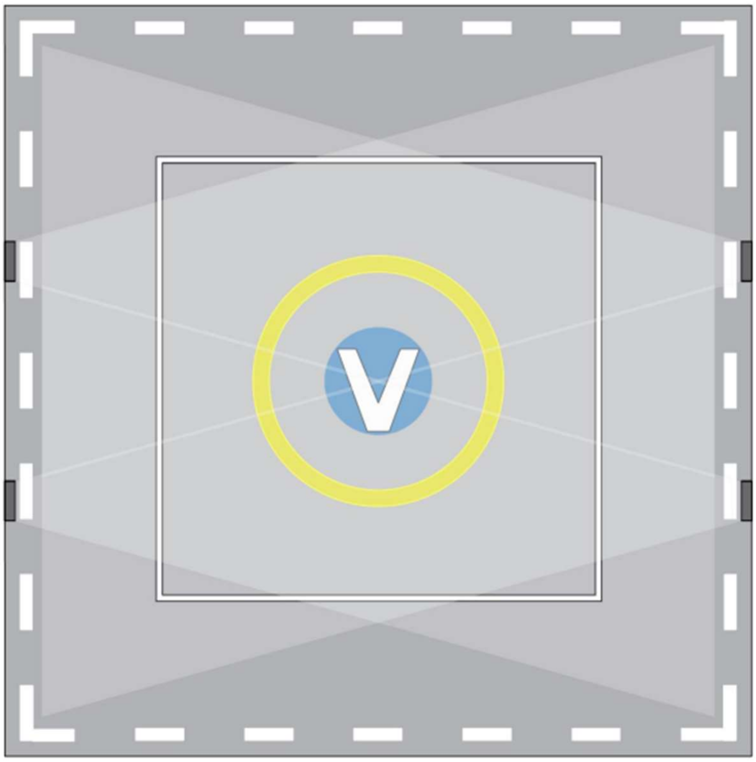


Figure 5.16 - Surface level FATO and TLOF with floodlighting (Illustration: EASA PTS-VPT-DSN).

5.22. Surface level FATO and TLOF with vertiport stand floodlighting

5.22.1. The objective of vertiport stand floodlighting is to provide illumination of the stand surface and associated markings to assist the manoeuvring and positioning of a VTOL aircraft, and to facilitate essential operations around the VTOL aircraft.

5.22.2. Vertiport stand floodlighting should be provided on a stand intended to be used at night by VTOL aircraft.

5.22.3. Vertiport stand floodlights should be located so as to provide adequate illumination, with a minimum of glare to the pilot of a VTOL aircraft in flight and on the ground, and to personnel on the stand. The arrangement and aiming of floodlights should be such that a VTOL aircraft stand receives light from two or more directions to minimise shadows.

5.22.4. The spectral distribution of stand floodlights should be such that the colours used for surface and obstacle marking can be correctly identified.

5.22.5. Horizontal and vertical illuminance should be sufficient to ensure that visual cues are apparent for required manoeuvring and positioning, and essential operations around the VTOL aircraft can be performed expeditiously without endangering personnel or equipment.

5.23. Taxiway lights

5.23.1. The specifications of CAP 168, Chapter 6: Aeronautical Ground Lighting are applicable to taxiways intended for ground taxiing of VTOL aircraft in the same manner as a taxiway meant for use by aeroplanes.

5.24. Visual aids for denoting obstacles

5.24.1. Obstacles should be marked and lit in accordance with CAP 168, Chapter 4: The assessment and treatment of obstacles.

5.24.2. If it is not possible to display obstacle lights on obstacles at a vertiport intended for use at night, the obstacles should be floodlit.

5.24.3. Obstacle floodlights should be arranged to illuminate the entire obstacle and as far as practicable, in a manner so as not to dazzle VTOL aircraft pilots.

5.24.4. Obstacle floodlighting should produce a luminance of at least 10 cd/m2.

6. Vertiport Emergency Response

6.1.1. Specific vertiport emergency response guidance has not yet been developed by the CAA. VTOL aircraft are powered by lithium-ion batteries, hydrogen fuel, or similar and the issue is whether the current rescue and firefighting services (RFFS) specifications for the aerodromes and heliports are adequate for the RFFS solutions dealing with VTOL aircraft fires. Currently, for aerodromes, including heliports, RFFS response is geared towards fighting kerosene fires and is likely to be ineffective at putting out battery fires. As VTOL aircraft will mostly be powered by lithium-ion batteries, hydrogen, or similar fuel, the current RFFS recommendations for will need to be reviewed and developed to include vertiports and VTOL aircraft. The CAA is working with partners such as Eurocae to assess risks and develop RFFS criteria for vertiports. Until such time that further guidance is made available, the establishment of emergency procedure and RFFS at aerodromes and heliports as provided in CAP168; Chapter 8 (including Appendix 8A-C) and Chapter 9, together with a risk assessment completed by the aerodrome operator in conjunction with the VTOL OEM and/or operator, should be referred to until further notice dependent on the type of facility used for the departure and arrival of VTOL aircraft and the aircraft itself.