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HELIPORT MANUAL

THIRD EDITION — 1995

Approved by the Secretary General and published under his authority

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Heliport Manual

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AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by

FOREWORD

Annex 14, Volume II, which became applicable on 15 November 1990, includes specifications on the planning, design and operation of heliports. The applicability of the visual aids part of the specifications is now limited to operations in visual meteorological conditions. However, Amendment No. 1 to Annex 14, Volume II, which is being processed for applicability in November 1995, will expand the specifications to support helicopter non-precision approaches. The purpose of this updated *Heliport Manual*, which replaces all previous editions, is to provide guidance in implementing the above-mentioned specifications.

The manual deals with three principal types of heliports, namely, surface level heliports, elevated heliports and helidecks which may be located on offshore installations or ships. The manual not only enlarges upon some of the specifications in Annex 14, Volume II, as necessary, but also provides guidance on aspects not dealt with in the Annex, e.g. site selection, winching areas, underslung load operating areas, etc.

Users of this manual are advised that specifications related to helicopter operations in other Annexes, for instance, Annex 6, Part III, *International Operations — Helicopters*, may vary somewhat from those specified in Annex 14, Volume II. In such cases, the more demanding requirements should be applied. To assist users of this manual, the characteristics of the majority of helicopter types currently in use have been included in an Appendix.

It is intended that the manual be kept up-to-date. Future editions will be improved on the basis of on-going studies by ICAO and on comments and suggestions received from the users of this manual. Therefore, readers are invited to provide their views, comments and suggestions on this edition. These should be directed to the Secretary General of ICAO.

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Chapter 1

SITE SELECTION AND STRUCTURAL DESIGN

Note.— Although by definition a heliport is an aerodrome for use by helicopters only, in this manual when the term aerodrome is used, it means an aerodrome designed primarily for the use of aeroplanes.

1.1 GENERAL

1.1.1 The particular advantages of the operation of helicopters, in that air services can be provided in very close proximity to the centres where traffic is generated, should be given full consideration when choosing a site. The selected site should also be conveniently situated as regards ground transport access and adequate vehicle parking facilities.

1.1.2 To minimize noise disturbance, the ambient noise level should be considered, particularly near noise sensitive buildings such as hospitals, schools and business premises and especially in relation to areas beneath the approach and departure paths of helicopters.

1.1.3 Heliport design and location should be such that downwind operations are avoided and cross-wind operations are kept to a minimum. Heliports should have two approach surfaces, separated by at least 150°. Additional approach surfaces may be provided, the total number and orientation ensuring that the heliport usability factor will be at least 95 per cent for the helicopters the heliport is intended to serve. These criteria should apply equally to surface level and elevated heliports.

1.1.4 Possible air traffic conflicts between helicopters using a heliport and other air traffic should be avoided. The need to provide air traffic control services may need to be examined.

1.1.5 For heliports used by performance class 2 and 3 helicopters the ground beneath the take-off climb and approach surfaces should permit safe one-engine-inoperative landings or forced landings during which injury to persons on the ground and damage to property are minimized. The provision of such areas should also minimize the risk of injury to the helicopter occupants. The main factors in determining the suitability of such areas will be the most critical helicopter type for which the heliport is intended and the ambient conditions.

1.1.6 The presence of large structures close to the proposed site may be the cause, in certain wind conditions, of considerable eddies and turbulence that might adversely affect the control or performance of the helicopters operating at the heliport. Equally, the heat generated by large chimneys under or close to the flight paths may adversely affect helicopter performance during approaches to land or climbs after take-off. Therefore it may be necessary to conduct wind tunnel or flight tests to establish if such adverse conditions do exist and, if so, to determine possible remedial action.

1.1.7 Other factors to be considered in the selection of a site are:

a) high terrain or other obstacles, especially power lines, in the vicinity of the proposed heliport; and

b) if instrument operations are planned, the availability of suitable airspace for instrument approach and departure procedures.

1.1.8 The essential components of a heliport are areas suitable for lift off, for the take-off manoeuvre, for the approach manoeuvre and for touchdown and, if these components are not co-located at a particular site, taxiways to link the areas.

1.1.9 Normally a site will have a simple layout which combines those individual areas that have common characteristics. Such an arrangement will require the smallest area over-all where the helicopter will be operating close to the ground and from which it is essential to remove all permanent obstacles and to exclude transient and mobile obstacles when helicopters are operating. When the characteristics or obstacle environment of a particular site do not allow such an arrangement, the component areas may be separated provided they meet their respective individual criteria. Thus a different direction may be used for take-off from that used in the approach and these areas may be served by a separate touchdown and lift-off area, located at the most convenient position on the site and connected to the other manoeuvring areas by helicopter ground taxiways or air taxiways.

1.2 SURFACE-LEVEL HELIPORTS

1.2.1 Final approach and take-off areas (FATOs)

1.2.1.1 A FATO is an area over which a helicopter completes the approach manoeuvre to a hover or landing or commences movement into forward flight in the take-off manoeuvre.

1.2.1.2 A touchdown may or may not be made on the FATO. It may be preferable to come to the hover and then air-taxi to a more desirable location for touchdown. Similarly, a helicopter may lift off from its parked location and air-taxi to the FATO where it assumes the hover before commencing the take-off manoeuvre.

1.2.1.3 All final approaches shall terminate at the FATO and all take-offs to climb shall start there.

1.2.1.4 A FATO may be any shape but it must be able to accommodate a circle whose diameter is at least equal to the dimension specified in Annex 14, Volume II, plus any rejected take-off area required.

1.2.1.5 When heliports are planned at high elevations or in places of high temperatures, the effects of the less dense air and/or high temperature result in reductions in both helicopter engine performance and rotor performance. In some helicopters this could mean that the power available is reduced below that which is required for the helicopter to climb vertically out of the ground effect without considerably reducing the gross take-off mass.

1.2.1.6 As a helicopter gains forward speed, the mass airflow through the rotor disc increases up to a certain speed and enhances lift. In consequence, the power required for horizontal flight is reduced, thus releasing more of the power available to be used for the climb.

1.2.1.7 In the field of commercial helicopter operations, an operation cannot be considered economically viable if the gross take-off mass is reduced to less than 85 per cent. In order to avoid this, a FATO of greater size than the statutory minimum dimensions should be provided, over which the helicopter can accelerate safely to its climbing speed before leaving the ground effect.

1.2.1.8 Table 1-1 gives guidance on the length of the FATO that should be provided for helicopters with limited climbing power, for a selection of altitudes and temperature conditions. In calculating the climbing speed, a maximum rotation angle of 10° should be considered commensurate with passenger comfort.

1.2.1.9 Helicopter flight manuals contain performance graphs which indicate combinations of forward speed and height above ground in which flight should be avoided since, in the event of engine failure, the probability of a successful forced landing is remote (see Figure 1-1). Therefore, to provide the helicopter with an area over which it can safely accelerate to avoid these unsafe combinations, it may be prudent to provide the sizes of FATO suggested in Table 1-1 in all cases except where otherwise required by Annex 14, Volume II.

1.2.1.10 Although helicopters are not intended to actually touch down on certain FATOs, it is possible that a helicopter may be forced into making an emergency landing on the area. Also, when a FATO is designed to accept performance class 1 helicopters, it must be capable of withstanding a rejected take-off, which may well equate to an emergency landing. Therefore the bearing strength of a FATO should cover an emergency landing with a rate of descent of 3.6 m/s (12 ft/s). The design load in this case should be taken as 1.66 times the maximum take-off mass of the heaviest helicopter for which the FATO is intended.

1.2.2 Water heliports

1.2.2.1 The physical characteristics of a water heliport are, in essence, the same as for a surface level ground heliport except that:

a) because the surface of a safety area and a FATO are the same at a water heliport, the safety area requirement at a water heliport designed for the use of performance class 2 and 3 helicopters is

Table 1-1. Acceleration distances required due to changes in altitude and temperature

CLIMBING SPEED	*40 kts*			*50 kts*			*60 kts*		
TEMPERATURE	*ISA-15° C*	*ISA*	*ISA+15° C*	*ISA-15° C*	*ISA*	*ISA+15° C*	*ISA-15° C*	*ISA*	*ISA+15° C*
HELIPORT ELEVATION feet	*ACCELERATION DISTANCE (metres (feet))*								
Sea level	118 (387)	124 (408)	131 (429)	184 (604)	194 (637)	204 (670)	265 (870)	280 (918)	294 (966)
1 000	121 (398)	128 (420)	135 (442)	190 (622)	200 (656)	210 (690)	273 (895)	288 (945)	303 (995)
2 000	125 (410)	132 (433)	139 (456)	195 (640)	206 (676)	217 (712)	281 (922)	297 (973)	312 (1 024)
3 000	129 (422)	136 (446)	143 (470)	201 (659)	212 (696)	223 (733)	290 (950)	306 (1 003)	322 (1 056)
4 000	132 (434)	140 (459)	148 (484)	207 (679)	219 (717)	230 (755)	298 (978)	315 (1 033)	332 (1 088)
5 000	137 (448)	144 (473)	152 (498)	213 (699)	225 (739)	237 (779)	307 (1 007)	324 (1 064)	342 (1 121)
6 000	141 (462)	149 (488)	157 (514)	220 (721)	232 (762)	245 (803)	316 (1 038)	335 (1 098)	353 (1 158)
7 000	145 (475)	153 (503)	162 (531)	226 (743)	240 (786)	253 (829)	326 (1 070)	345 (1 132)	364 (1 193)
8 000	149 (490)	158 (519)	167 (548)	233 (766)	247 (811)	261 (856)	336 (1 103)	356 (1 167)	375 (1 231)
9 000	154 (505)	163 (535)	172 (565)	241 (790)	255 (836)	269 (882)	346 (1 135)	366 (1 202)	387 (1 269)
10 000	159 (521)	168 (552)	178 (583)	248 (815)	263 (863)	278 (911)	358 (1 174)	379 (1 243)	400 (1 312)

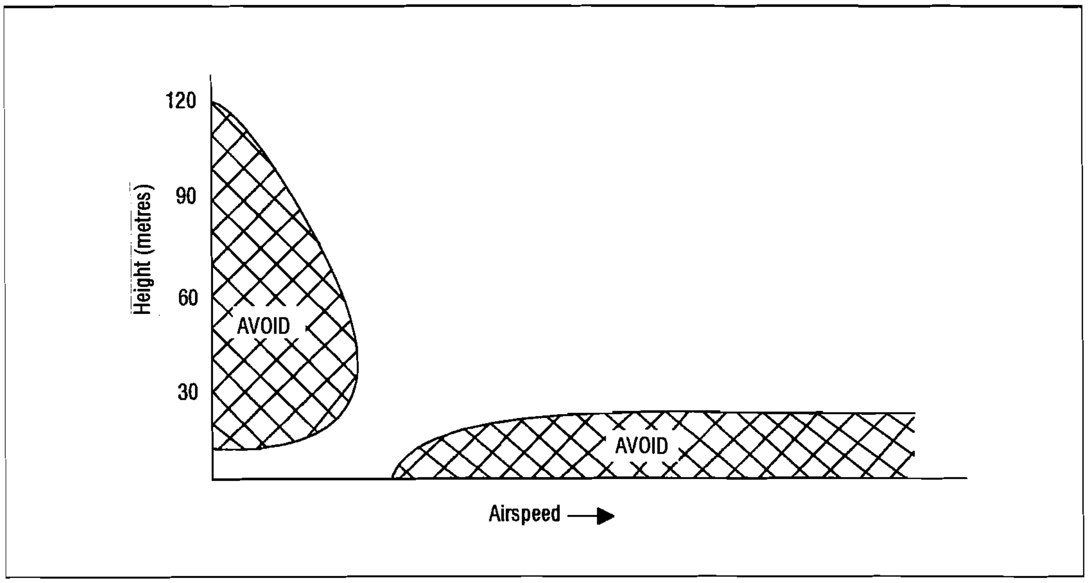


Figure 1-1 Typical combinations of height and airspeed to be avoided

discarded and, instead, the size of the FATO is correspondingly increased;

b) instead of slope limitations on the surfaces of FATO and any associated water taxiways, consideration should be given to wave heights;

c) surface bearing strength is replaced by water depth; and

d) in addition to wind effects, the effect of currents, where applicable, should also be taken into account.

1.2.2.2 *Final approach and take-off area*

1.2.2.2.1 When deciding upon the location of the FATO, it must be ensured that conflict with other water users is reduced to a minimum. This will apply equally when deciding upon the approach and departure directions.

1.2.2.2.2 The effect of rotor downwash and noise on small craft and sailing and fishing vessels can be very serious and should be considered when locating the FATO.

1.2.2.2.3 All approaches and take-off paths should be routed over land, when feasible.

1.2.2.2.4 Consideration of these points may also lead to the decision whether a helicopter should approach to the hover above the FATO and thence air taxi to a touchdown and lift-off area on the land, or touch down on the FATO followed by water taxiing to a mooring area.

1.2.2.2.5 Air traffic control will be necessary and close liaison with the relevant water authorities will be essential.

1.2.2.3 *Wave height*

1.2.2.3.1 Although generally of little significance on inland water areas, waves can be a significant problem in coastal areas. The limits on the height of waves that can be accepted will depend upon individual helicopter types and the types of flotation gear with which they are fitted.

1.2.2.3.2 Details of the maximum acceptable wave heights should be given in the helicopter flight manuals for each helicopter type.

1.2.2.4 *Water depths*

1.2.2.4.1 Again, the water depth required for waterborne operations will depend upon the individual helicopter size, weight and its type of flotation gear and it should be remembered that rotor downwash causes a concave depression in the water beneath the helicopter and thus reduces water depth.

1.2.2.4.2 Water depth should be sufficient to accommodate the heaviest or largest helicopter that the FATO and associated water taxiways are intended to serve.

1.2.2.4.3 Water depth will thus dictate how close a water taxiway can safely extend to the shore to reach the mooring area.

1.2.2.5 *Water currents*

1.2.2.5.1 When the direction of the water current is opposite to the wind direction, the current may be stronger than the wind and cause the landed helicopter to drift out of the FATO. In such instances, the pilot will need to progressively tilt the helicopter's rotor disc rearwards in order to maintain the position on the FATO. This rearward tilting of the rotor disc might then be increased by the effect of the wind and thus produce a risk of the main rotor blades striking the tail assembly.

1.2.2.5.2 Although this is primarily an operational problem, a pilot must be informed if these water current conditions exist, and they should be considered when siting the FATO and when notifying the pilot of landing and take-off directions. Out-of-wind or cross-current directions may be preferable.

1.3 ELEVATED HELIPORTS

1.3.1 General

1.3.1.1 Helicopter operations are located on elevated sites normally only when there is no suitable space at ground level, however, security or convenience may also influence the choice of site.

1.3.1.2 Safe operations for helicopters at a ground level site require the availability under approach and departure routes of open spaces suitable for an emergency landing or a rejected take-off. It is equally necessary to have cleared spaces for the same purposes for those helicopters operating at an elevated site, particularly in the immediate vicinity of the site.

1.3.1.3 The determination of optimum operating mass for multi-engined helicopters using an elevated heliport may require the availability of obstacle-free airspace to well below the elevation of the FATO. Attention must be given, therefore, to the relative height and proximity of other structures when planning approach and departure routes.

1.3.1.4 In the event of the failure of a power unit in a performance class 3 helicopter during the early stages after lift-off or during the final stages of the approach to land, the helicopter will almost certainly be in a configuration of height and forward speed from which a safe autorotative emergency landing would be improbable. Such combinations of height and airspeed would come within the area of performance to be avoided, which is plotted on a graph for the helicopter type. Therefore performance class 3 helicopters should not be permitted to operate at elevated heliports.

1.3.1.5 Items such as air vents or lift machinery housings, commonly located on the roofs of large, tall buildings, can be not only hazardous to the safety of the helicopter but also the cause of considerable turbulence. Therefore they should be below the level of the FATO whenever possible and, in any case, be situated well clear of the FATO plus safety area.

1.3.2 Structural design

1.3.2.1 Elevated heliports may be designed for a specific helicopter type though greater operational flexibility will be obtained from a classification system of design. The FATO should be designed for the largest or heaviest type of helicopter that it is anticipated will use the heliport, and account taken of other types of loading such as personnel, freight, snow, refuelling equipment, etc. For the purpose of design, it is to be assumed that the helicopter will land on two main wheels, irrespective of the actual number of wheels in the undercarriage, or on two skids if they are fitted. The loads imposed on the structure should be taken as point loads at the wheel centres, shown in Table 1-2.

1.3.2.2 The FATO should be designed for the worse condition derived from consideration of the following two cases.

1.3.2.3 *Case A — Helicopter on landing*

When designing a FATO on an elevated heliport, and in order to cover the bending and shear stresses that result from a helicopter touching down, the following should be taken into account:

a) *Dynamic load due to impact on touchdown.*

   This should cover the normal touchdown, with a rate of descent of 1.8 m/s (6 ft/s), which equates to the serviceability limit state. The impact load is then equal to 1.5 times the maximum take-off mass of the helicopter.

   The emergency touchdown should also be covered at a rate of descent of 3.6 m/s (12 ft/s), which equates to the ultimate limit state. The partial safety factor in this case should be taken as 1.66. Hence:

the ultimate design load = 1.66 service load
= (1.66 x 1.5) maximum take-off mass
= 2.5 maximum take-off mass

To this should be applied the sympathetic response factor discussed at b) below.

b) *Sympathetic response on the FATO.*

The dynamic load should be increased by a structural response factor dependent upon the natural frequency of the platform slab when considering the design of supporting beams and columns. This increase in loading will usually apply only to slabs with one or more freely supported edges. It is recommended that the average structural response factor (R) of 1.3 should be used in determining the ultimate design load.

c) *Over-all superimposed load on the FATO (S_{H_a}).*

To allow for snow load, personnel, freight and equipment loads, etc., in addition to wheel loads, an allowance of 0.5 kilonewtons per square metre (kN/m^2) should be included in the design.

d) *Lateral load on the platform supports.*

The supports of the platform should be designed to resist a horizontal point load equivalent to 0.5 maximum take-off mass of the helicopter, together with the wind loading (see f) below), applied in the direction which will provide the greater bending moments.

e) *Dead load of structural members.*

The partial safety factor to be used for the dead load should be taken as 1.4.

f) *Wind loading.*

In making the assessment of wind load, the basic wind speed (V), appropriate to the location of the structure, is the three second gust speed estimated to be exceeded, on the average, once in 50 years. The basic wind speed is then multiplied by three factors — the topography factor (ground roughness), the factor of building size and height above ground and a statistical factor which takes into account the period of time in years during which there will be exposure to wind. This will give the design wind speed (V_s) which is then converted to dynamic pressure (q) using the relationship $q=kV_s^2$ where k is a constant. The dynamic pressure is then multiplied by an appropriate pressure coefficient Cp to give the pressure (p) exerted at any point on the surface of the structure.

g) *Punching shear.*

Check for the punching shear of an undercarriage wheel or skid using the ultimate design load with a contact area of 64.5×10^3 mm^2.

Note.— The above design loads for helicopters on landing are summarized in Table 1-3.

Table 1-2. Details of point loads and over-all superimposed loads

Helicopter category	*Maximum take-off mass (kg)*	*Maximum take-off mass (kN)*	*Point load for each wheel (kN)*	*Under-carriage wheel centres (m)*	*Super-imposed load (S_{H_a}) (kN/m^2)*	*Super-imposed load (S_{H_b}) (kN/m^2)*
1	up to 2 300	up to 22.6	12.0	1.75	0.5	1.5
2	2 301 — 5 000	22.6 — 49.2	25.0	2.0	0.5	2.0
3	5 001 — 9 000	49.2 — 88.5	45.0	2.5	0.5	2.5
4	9 001 — 13 500	88.5 — 133.0	67.0	3.0	0.5	3.0
5	13 501 — 19 500	133.0 — 192.0	96.0	3.5	0.5	3.0
6	19 501 — 27 000	192.0 — 266.0	133.0	4.5	0.5	3.0

Table 1-3. Summary of design loads — Cases A and B

	Design load for helicopter on landing — Case A
Superimposed loads	
Helicopter	2.5 $L_H R$ distributed as two point loads at the wheel centres for the helicopter category given in Table 1-2. Average value for R = 1.3.
Lateral load	1.6 $\frac{L_H}{2}$ applied horizontally in any direction.
Over-all superimposed load	Load at platform level together with the maximum wind loading. 1.4 S_{H_a} over the whole area of the platform. (S_{H_a} given in Table 1-2).
Dead load	1.4G
Wind loading	1.4W
Punching shear check	2.5 $L_H R$ load over tyre or skid contact area of 64.5 x 10^3 mm^2.

	Design load for helicopter at rest — Case B
Superimposed loads	
Helicopter	1.6 L_H distributed as two point loads at the wheel centres for the helicopter category given in Table 1-2.
Over-all superimposed load (personnel, freight, etc.)	1.6 S_{H_b} over the whole area of the platform. S_{H_b} given in Table 1-2.
Shear check	Check as appropriate.

Symbol	*Meaning*
L_H	Maximum take-off mass of helicopter
G	Dead load of structure
W	Wind loading
R	Structural response factor
S_{H_a}	Superimposed load — Case A
S_{H_b}	Superimposed load — Case B

Partial load factors	
Dynamic load (ultimate design load)	2.5
Live load	1.6
Dead load	1.4
Wind loading	1.4

1.3.2.4 *Case B — Helicopter at rest*

When designing a FATO on an elevated heliport, and in order to cover the bending and shear stresses from a helicopter at rest, the following should be taken into account:

a) *Dead load of the helicopter.*

Each structural element must be designed to carry the point load, in accordance with Table 1-2, from the two main wheels or skids applied simultaneously in any position on the FATO so as to produce the worst effect from both bending and shear.

b) *Over-all superimposed load (S_{H_b}).*

In addition to wheel loads, an allowance for over-all superimposed load given in Table 1-2, over the area of the FATO, should be included in the design.

c) *Dead load on structural members and wind loading.*

The same factors should be included in the design for these items as given for Case A.

Note.— The above design loads for helicopters at rest are summarized in Table 1-3.

1.3.2.5 Normally, the upper load limit of the helicopter category selected should be used for design purposes except as follows:

In order to avoid over-design in the platform the upper limit in any band may be exceeded by 10 per cent should the maximum take-off mass of a helicopter fall just into the next highest category. In such cases, the upper limit of the lower helicopter category should be used in the design.

1.3.3 Personnel safety

1.3.3.1 Where there is a sheer drop from the edges of the heliport and the free movement of passengers and heliport personnel cannot be made without some risk, a safety net should be installed.

1.3.3.2 The net should extend outwards to at least 1.5 m from the edges of the safety area and be capable of withstanding, without damage, a 75 kg mass being dropped from a height of 1.0 m. It should be so manufactured that it provides a hammock effect for a person falling into it rather than the trampoline effect produced by some rigid materials.

1.4 HELIDECKS ON OFFSHORE INSTALLATIONS

1.4.1 General

1.4.1.1 The location of a helideck on a fixed or mobile installation is often a compromise between the conflicting demands of basic design requirements, space limitations and the need for the installation to provide for a variety of functions. Where the statutory helideck design parameters cannot be fully met, it may be necessary for restrictions to be imposed upon helicopter operations, based upon tests, for example in relation to wind velocity.

1.4.1.2 Where it is likely that the availability of a single helideck on an installation would impose severe restraints upon the regularity of a helicopter operation, it may be advisable to provide two separate helidecks, probably diametrically opposed, each satisfying, as far as possible, the specified criteria.

1.4.1.3 The helideck should be so located that the required clear approach and take-off sector is available, making best use of the prevailing winds, and the FATO is least affected by structure-induced turbulence or by high temperatures and turbulence from the exhausts of gas turbines. Helidecks which are located directly upon deep, slab-sided structures, such as accommodation areas, are liable to suffer from excessive vertical airflow components unless there is sufficient separation to allow airflow beneath the helideck. The combined effects of airflow direction and turbulence, prevailing wind and exhaust stack emissions should be determined for each installation and this information should be made available to the helicopter operator. As a general rule, the vertical airflows resulting from winds of up to 25 m/s should not exceed ±0.9 m/s over the FATO at the main rotor height.

1.4.1.4 Where gas turbines are installed whose exhaust gases may affect helicopter operations, some form of exhaust plume indication, for example by the production of coloured smoke, should ideally be provided for use during helicopter operations. A survey of ambient temperatures should be conducted when the wind is flowing directly from the turbine exhaust ducts towards the helideck. When the ambient temperature in increased by more than 2° to 3°C the helicopter operator must be advised. It may be necessary, in difficult cases, for some form of permanent heat sensor instrumentation to be installed to give guidance to the helicopter pilot on the temperature profile whilst operations at the installation are in progress.

1.4.1.5 It should be noted that turbulence from turbine exhausts may be as great a hazard to the smaller helicopters as is the associated increase in temperature.

1.4.1.6 It is desirable, particularly on fixed installations, that to meet the required safety criteria, the helideck should be located at or above the height of the highest point of the main structure. However, in so doing, it should be recognized that if this entails a helideck much in excess of 60 m above sea level, the regularity of helicopter operations in some sea areas may be adversely affected by low cloud base conditions. Conversely, low elevation helidecks may also adversely affect helicopter operations due to the one-engine-inoperative performance safety requirements.

1.4.2 Effects of airflows over offshore installations

1.4.2.1 The detailed pattern of airflows over offshore installations is a complex matter, being dependent upon the precise configuration of the installations, the state of the sea and the general atmospheric environment. Nevertheless, these airflows fall into a general class, particularly in conditions of strong winds and neutrally stable atmosphere and can be described in terms of their over-all structure.

1.4.2.2 Essentially, the wind must pass over and around a three-dimensional isolated bluff block elevated on legs above the sea surface. As far as the gross effects are concerned, it is the over-all bulk of the installation that disturbs the oncoming flow and, in general, the role of the numerous protrusions is secondary, confusing the situation rather than drastically altering the general pattern.

1.4.2.3 Many of these influences can be viewed simply in terms of the physical scales of the flow-disturbing obstacles, since it is always necessary to relate sizes and distances to the overriding geometric parameters of platform thickness, length and breadth.

1.4.2.4 Apart from such over-all considerations, module shape cannot be ignored completely when assessing the potential effect of a configuration. However, a limited number of general principles can be offered to explain most observed phenomena, although accurate prediction of these flows is a difficult matter.

1.4.2.5 Wind tunnel experiments have been carried out to investigate salient flow features around simple platform models, with special regard to the suitable location of helidecks, and have resulted in some general criteria for helideck positioning.

1.4.2.6 Firstly, it is apparent that variations in platform geometry do not critically affect the flow of air, but the aerodynamic characteristics of a specific platform design are very different where solid (non-porous) structures are concerned from those associated with open lattice-type structures. Therefore, in deciding the best location for the helideck the designer should adopt the following simplistic approach to this difficult design problem:

a) simplify the platform design into solid blocks and lattice structures;

b) recognize that helidecks level with or below a block will always be subject to a turbulent separated flow from some wind directions;

c) consider whether a system of edge slats or turning vanes can be used to reduce the turbulent effects over the helideck or if the only alternative solution is to raise the helideck;

d) accepting that winds normal to the salient edges are the most demanding in terms of depth of influence, examine potential helideck positions for height and distance from upstream edges. Provide an elevation of 0.2t at a leading edge, increasing to 0.5t at a distance t from the edge and maintaining this height for distances up to 3t, where t is the relevant local obstruction height; and

e) such elevations will, in general, produce a reasonable flow environment. Any less elevation may prove to be more critical to other wind angles for, although the separated flow behind an inclined block may be less deep, steadier downflows can exist in the region of the helideck.

1.4.2.7 These considerations are given to enable the generation of a broadly satisfactory flow environment for helicopter operations. In addition, the platform's primary function dictates highly restrictive constraints on helideck placement. The reconciliation of the various conflicting demands is necessarily the province of the designer who must also consider the effects of exhaust plume dispersal and cooling and other related environmental facets. If more quantitative information is required, the designer must resort to wind tunnel tests for a particular installation configuration.

1.4.3 Effects of temperature increases at offshore installations

1.4.3.1 As offshore structures have become larger and more complex, larger power generation plants have been necessary which, in turn, have produced adverse effects on the general platform environment through emission of hot exhaust plumes. Furthermore, it is inevitable on an offshore installation that the many sensitive systems are in much closer proximity than they would be on an on-shore ground level site and some interaction is bound to take place.

1.4.3.2 Amongst the many effects of hot exhaust gases, one of the major aspects to be considered is the resulting modification of helicopter performance. Sudden increases in the environmental temperature over ambient can cause an abrupt loss of engine and rotor performance at a most critical stage of the helicopter operation.

1.4.3.3 The emission of the exhaust gas is usually in the form of a number of turbulent jets, which are injected into the complex turbulent flow that exists round the installation. The result is an interaction process which produces great variation in the rates of spreading and cooling individual plumes. The properties of the temperature field can be measured by wind tunnel model testing. However, because of the limited scope from a few scales of length, velocity and temperature, the results achieved can be used only as a guide to the type of phenomena that can exist in general, and to the relative levels of temperature that can be expected.

1.4.3.4 As a plume develops, with an origin relatively clear of the helideck, the individual identity of the separate jets is gradually lost as the hot cloud merges into one plume. Accordingly, the temperature is reduced and is more evenly distributed. By elevating the outlets sufficiently, the helideck can be kept clear of hot gas, but the resulting concentrated plume constitutes a considerable helicopter hazard. By lowering the outlet positions into the separated flow around the platform an increase in the dispersion of the plume can be obtained and the centreline temperature can be markedly reduced. However, the spread of the exhaust may become so great that almost all parts of the structure are contaminated under some wind conditions. Quantitative tests thus become necessary to assess the acceptability of such a design.

1.4.3.5 Long, downward-directed outlets will remove most of the problems of plume interference with helicopter operations and should be satisfactory for the installation over-all if suitable gas turbine and heating and ventilation intake positions can be made available. Even so, it is always advisable to test a specific configuration and associated gas turbine system with reference to particular sensitive locations. It is stressed that, when doing so, consideration must be given to the dynamic nature of the sensitive system, gas turbine intakes or the general environment, so that due regard may be taken of the strong fluctuations in temperature that may exist.

1.4.3.6 Helicopter performance may also be seriously impaired as a result of the combined radiated and convected heat effects from flare plumes under certain wind conditions. In moderate or stronger winds, the radiated heat is rapidly dissipated and presents little problem for the helicopter pilot provided flight through the flare plume is avoided. However, in calm or light wind conditions the changes in temperature around the helideck can be very marked and localized and the helicopter may undergo a sudden unexpected loss of performance just as it is about to cross the edge of the helideck.

1.4.3.7 Designers should, therefore, exercise great care in the location and elevation of flare towers in relation to helicopter operations.

1.4.4 Personnel safety

1.4.4.1 Safety nets for the protection of personnel should be installed around the helideck except where structural protection exists. The netting used should be of a flexible nature and be manufactured from non-flammable material. The inboard edge should be fastened level with, or just below, the edge of the helideck, including drainage, guttering, etc. The net itself should extend at least 1.5 m in the horizontal plane and be so arranged that the outboard edge is slightly above the level of the helideck edge, but by not more than 0.25 m, having an upward and outward slope of at least 10°. The net should be strong enough to withstand, without damage, a 75 kg mass being dropped from a height of 1.0 m.

1.4.4.2 A safety net designed to meet these criteria may nevertheless be too rigid and act as a trampoline giving a "bounce" effect. Further, if lateral or longitudinal centre bars are provided to strengthen the net structure, there is a risk of serious injury to persons falling across them. The ideal design should produce a "hammock" effect which should securely contain a body falling or jumping into the net, without injury.

1.4.4.3 Many helicopters have passenger access on one side only, therefore helicopter landing orientation in relation to helideck access points is important to ensure that embarking and disembarking passengers are not required to pass around a helicopter with a low profile rotor when a rotors-running turn-round is conducted.

1.4.4.4 Ideally there should be a minimum of three access points to the helideck, located equidistant around the perimeter. However, if the helideck extends beyond the main structure below by more than 50 per cent, then two of the access points should be located in this overhang area. Such an arrangement will ensure that, in the event of an accident or incident on the helideck from which fire might ensue, personnel will be sure of at least one escape route upwind of the helideck.

1.4.4.5 Where hand rails associated with access points exceed the elevation of the FATO by more than 25 cm (10 in), they shall be made collapsible or removable. They shall be collapsed or removed whilst helicopter manoeuvres are in progress.

1.4.5 Control of crane movement

1.4.5.1 It is particularly important that all crane movements on the installation and in the immediate environment are controlled efficiently. The 210° obstacle-free sector of the helideck must not be infringed upon by any cranes or parts thereof during helicopter movements. All cranes in the vicinity of the FATO which may, during their operation, encroach into the 210° sector or the 150° limited obstacle sector must cease movement during helicopter operations. Not only can the physical presence of cranes in the sensitive areas constitute decided hazards to operating helicopters, but crane movement, even in a safe location, can distract a pilot's attention at a critical stage of an operation. It is desirable, therefore, that all cranes, both on the installation and on any attendant installations or vessels be stationary and, if practicable, be lowered and stowed clear of the obstacle-free and limited obstacle sectors during all helicopter movements at the installation.

1.4.5.2 It is desired, and indeed, required by some regulating authorities that the person in charge of the installation or vessel shall issue written instructions to the above effect.

1.4.6 Structural design strength

When considering the structural design strength of any helideck, the guidance given for an on-shore elevated heliport shall apply (see 1.3.2 to 1.3.2.5 inclusive and Tables 1-2 and 1-3).

1.4.7 Types of offshore installation and support vessel

1.4.7.1 Offshore installations can be classified generally as fixed or mobile.

1.4.7.2 Each operating offshore oil or gas field will normally contain at least one fixed installation. It would be designated the key platform in the field or in a section of a large field where exploration has revealed that the mineral source extends over a large area beneath the sea and warrants more than one operating area to extract the mineral.

1.4.7.3 Each fixed installation usually will be supported by one or more mobile installations, either on a temporary basis or in the longer term of the useful life of the oil/gas field, dependent upon the functional capabilities of the key platform. In some fields it has been found to be more economically viable, at least in the short term, to adapt a mobile installation and use it as a fixed platform.

1.4.7.4 Mobile installations are also used independently in the exploration of new fields where their manoeuvring ability renders them of major economic use.

1.4.7.5 Various support vessels, such as crane or derrick barges, pipe-laying vessels, maintenance vessels and floating storage units (FSUs) are also employed extensively in the oil/gas fields. They are usually specifically designed or modified for a particular function which makes their use especially valuable.

1.4.7.6 *Fixed installations*

1.4.7.6.1 These installations are fixed to the sea bed and thus provide the most stable platforms for offshore helicopter operations. These are also usually large structures, which should normally be capable of providing adequate space for the accommodation of helicopter requirements. However, because an installation is fixed and constitutes the key platform in the field, it necessarily carries quantities of large equipment, pipework and functionally essential structures which limit the space available for helicopter operations unless they have been specifically catered for in the design of the installation.

1.4.7.6.2 All modern offshore installations are designed with helicopter operations in mind. However, there are many older installations in use which were designed before helicopters were generally used in support. The subsequently added helidecks are consequently often small and able to accept only the smaller types of helicopter.

1.4.7.6.3 Alternatively, new helidecks can be provided by employing a cantilever type of construction and placing most of the helideck outside the main structure. This should provide the greater angle required for the obstacle-free sector and approach area. Great attention must be given, however, to ensure that such structures do not exceed the centre of gravity limits of the installation, particularly if the helideck is located high upon the installation.

1.4.7.6.4 Some satellite platforms may be fixed by a single-point mooring. They usually provide only the smaller helidecks although, in most cases, they are able to provide obstacle-free approach and take-off areas well in excess of the minimum 210° required. Such platforms are very prone to sea movements, however, and may very well roll from side to side and heave up and down, while at the same time swinging laterally about the mooring. Therefore restrictions may be imposed on helicopter operations by the appropriate aviation authority.

1.4.7.7 *Semi-submersible installations*

1.4.7.7.1 These are mobile installations that can move under their own power or be towed. They float by means of at least two large pontoons. When in position in an oil/gas field they are secured to the sea bed by several chains and anchors. Since part of the structure is under water, they are able, normally, to provide stable, suitably dimensional helidecks with clear approaches. It must be ensured, however, that the anchor attachment points do not constitute obstacles in the critical areas adjacent to the helideck. Cranes must cease operations and be stowed during helicopter operations and, when in use, they must not interfere with operations to helidecks on other installations or vessels.

1.4.7.7.2 When a semi-submersible is moored alongside another installation, it must be ensured that all approaches to its helideck remain available and clear or the helideck should be closed for operations. Helicopters must then use the helideck on the parent installation. Similarly, the position of the semi-submersible must not infringe upon the approaches to the helideck on the parent installation.

1.4.7.8 *Jack-up installations*

1.4.7.8.1 Jack-up rigs are also mobile installations, but almost always need to be towed between locations. They consist of tall, latticed legs, usually three in number, between which the main structure can be raised or lowered to a suitable height above water level. The legs sit on the bed of the water area and are suitably anchored to give a stable platform.

1.4.7.8.2 These installations are suitable for use in more shallow waters only and thus are less adaptable than the semi-submersibles. Additionally, with the legs set in a triangular configuration in most cases, it is impossible to locate a helideck on the main structure and provide the required 210° obstacle-free sector. Therefore, the helideck must be provided outside the main structure, which probably means being supported by a cantilever type of construction.

1.4.7.8.3 With this type of construction, the centre of gravity problem mentioned in 1.4.7.6.3 applies, particularly when the rig is being moved. For this reason, the main structure is usually lowered to the minimum practicable position on the jack-up legs prior to being towed. However, such a position so close to the water level renders the helideck liable to be swamped by heavy seas with consequent deterioration of the materials used in the helideck construction. Therefore, the helideck must be swabbed clean of all salt water deposits as soon after the movement is completed as is possible.

1.4.7.9 *Support vessels*

All vessels used in support of oil/gas exploration and exploitation operations will, almost invariably, be provided with purpose-built helidecks. Probable exceptions will be the small safety vessels which attend each installation. Therefore the requirements shall be the same as for the offshore installation or, in the case of the exceptions, for heliports on ships given in 1.5.2.

1.4.7.10 *Obstacle-free surfaces*

It is most important for the safe and expeditious flow of helicopter traffic that mobile installations and support vessels observe the 180° obstacle-free surfaces, not only as applied to their own helidecks but also of the helidecks on all other installations and/or support vessels in the oil/gas field in which they are operating.

1.5 HELIDECKS ON SHIPS

1.5.1 Helidecks on ships

1.5.1.1 When helicopter platforms are provided in the bow or stern of a vessel or are purpose-built in some other location above the vessel's structure, they are to be regarded as helidecks and the criteria applied to helidecks on offshore installations shall apply equally to these platforms.

1.5.1.2 When, however, such helidecks cannot be provided with the full 210° obstacle-free area or the full required FATO size is not possible, the helideck may be acceptable to helicopters of smaller over-all dimensions or after the imposition of certain limitations on helicopter operations. Such acceptance should be the responsibility of the appropriate aviation authority to whom application should be made.

1.5.1.3 Because the ability of a vessel to manoeuvre may be helpful in providing an acceptable wind direction in relation to the FATO location, the authorities should be notified whether the vessel is normally fixed at anchor during helicopter operations, single point moored or semi or fully manoeuvrable. The authorities may then specify the effective minimum wind speed and crosswind components acceptable when giving clearance for the helideck.

1.5.1.4 Although helidecks located amidships are less liable to the extreme vessel movement experienced at bow or stern locations, details of motions of the vessel in pitch, roll, yaw or heave are to be notified to the pilot prior to and during all helicopter movements. The limitations on these movements should be recorded in the helicopter operator's operations manual.

1.5.1.5 A poop deck location, that is, the raised deck in the stern of the vessel, is often used because of the shortage of suitable space on the main deck. However, such a location can have the following disadvantages:

a) air turbulence caused by wind effects on the superstructure may produce handling problems when manoeuvring the helicopter;

b) flue gases may adversely affect helicopter performance or even affect the pilot; and

c) excessive pitch, roll and heave may be experienced at this extreme end of the ship and may preclude helicopter operations.

1.5.1.6 These problems may be overcome by providing a suitably designed, purpose-built helicopter platform and by manoeuvring the ship so that the direction of the wind is within 35° of the beam, preferably on the port side, prior to the helicopter approaching or taking off.

1.5.2 Heliports on ships

1.5.2.1 *FATO in amidships location*

1.5.2.1.1 On some vessels supporting offshore mineral exploration and exploitation, particularly crane barges, pipe laying barges, etc., the only location available for a FATO and which will provide two approach paths, is usually amidships and then only in a highly obstructed environment. This is due to the very nature of the role of the vessel and its consequent structure and equipment. This location, however, minimizes the effects of the vertical movements of the vessel.

1.5.2.2 *FATO at ship's side location*

1.5.2.2.1 On some ships, notably tankers, even the space amidships is precluded from accommodating a FATO by pipelines and derrick booms. Therefore provision has to be made for the FATO at the ship's side.

1.5.3 Special types of ships

1.5.3.1 *Oil tankers*

In spite of the hazardous nature of their cargo, tankers are probably the most suitable ships on which to operate helicopters. Correct gas control procedure, backed up by other safety procedures, virtually removes any hazards which may result from gases from the cargo. On all ships with accommodation areas aft, the large area of deck space, comparatively free from obstructions, provides a suitable helicopter operating area. Smaller tankers may be able to provide a winching area only whereas the larger tankers may provide a FATO on one side of the ship and a winching area on the opposite side. The deck space on smaller tankers is usually more cluttered and manoeuvring areas tend to be restricted by derrick posts, cranes, masts, gas risers, etc.

1.5.3.2 *Chemical/parcel tankers*

In general, because of their special construction, these ships are not suitable for routine helicopter operations. The multitude of horizontal and vertical pipes, ventilator pipes and deck tanks usually means that no space is available to establish a landing or winching area. Helicopter operations to these ships should, therefore, be carried out in an emergency only.

1.5.3.3 *Gas tankers*

Helicopter operations are carried out, by preference, on or above the main decks of these tankers, wherever there is enough space.

1.5.3.4 *Bulk carriers*

Generally the bulk carriers are designed so that much of the main deck area is taken up with large hatch covers, leaving relatively little clear deck space on either side of the hatches. This usually means that helicopter operating areas must be sited on the hatch covers. It is essential that such hatch covers be approved by the appropriate authority as having sufficient bearing strength to accommodate the most critical helicopter for which the operations are intended. It is emphasized that the whole of the FATO would need to be located on the hatch covers and shall not overlap on to the side deck areas. Thus most bulk carriers will be able to meet the requirements for a winching area only.

1.5.3.5 *Geared bulk carriers*

1.5.3.5.1 This type of ship generally falls into the smaller size range and is normally capable of providing a winching area. The design of these ships varies considerably but most have a significant number of tall obstructions in the form of cargo-handling gear, which complicates the siting of a suitable helicopter operating area. It may be possible to site the area on hatch covers. However, the close proximity of obstacles may require its siting on the main deck with a significant portion of the manoeuvring area extending outboard of the ship's side.

1.5.3.5.2 The following points should be considered:

a) the area should not be located well forward because of turbulence around the ship's bow, coupled with the potential problems of spray or breaking seas due to the relatively low freeboard in the laden condition; and

b) the presence of tall obstacles on the main deck requires that provision be made for clear approach and departure paths to and from the operating area.

1.5.3.6 *Gearless bulk carriers*

1.5.3.6.1 These ships are usually free from tall obstacles on deck and offer both a clear approach/departure path and greater flexibility in siting an operating area, which is normally on the hatch covers. These may have some minor obstacles on them, such as ventilator trunkings, which can affect the positioning of the clear zone.

1.5.3.6.2 The following points must be considered when siting helicopter operating areas on the hatch tops:

a) *Fore and aft opening*. These hatch covers are normally either totally flat or transversely corrugated. The totally flat configuration is ideally suited for both landing and winching operations. Transversely corrugated hatch covers are not suited to helicopter operations but the operating areas can usually be sited on the main deck.

b) *Side opening*. The hatch covers are suitable for landing or winching, but many are not totally flat and can slope by as much as 5°, normally from the half-length towards either end. This factor is even more critical when added to the rolling motion of the ship and may exceed the slope limitations specified for the helicopter.

1.5.3.7 *Combination carriers*

Design features on both types of combination carrier, namely the ore/bulk/oil carriers (OBO) and the ore/oil carriers (O/O), are similar to the bulk carriers. A FATO or winching area will normally be sited on the hatch covers, although it may be possible on the large O/O ships to site the area on the main deck as greater clear deck space is usually available. Minor obstacles on the hatch covers, such as vent hatches or tank cleaning equipment, may determine where the operating area will be situated. Combination carriers are relatively free of large obstacles although the derrick posts near the manifolds usually combine to take the tanks' gas vent risers. Combination carriers almost invariably are fitted with side opening hatch covers (see 1.5.3.6.2 b)).

1.5.3.8 *Container ships*

1.5.3.8.1 Unless specially designed, a container ship does not readily lend itself to routine helicopter operations as maximum use is made of the weather deck for the stowage of the containers. In most cases this precludes helicopter landing or winching operations to anywhere but:

a) hatches which are clear of containers; or

b) the top of the deck container stack.

1.5.3.8.2 Although these areas should be able to meet the recommendations for the space required for helicopters landing or winching, the availability of clear spaces is usually limited due to the positioning of containers on deck. Clearance on bearing strength of the hatch covers should be obtained from the appropriate authority for the operation of helicopters.

1.5.3.8.3 Serious consideration must be given to the following points if helicopter operations are proposed from the top of the deck container stack:

a) containers on deck can routinely be stacked as many as five high (up to 14 m above the deck) and are also likely to extend the full width of the ship;

b) unless specialized arrangements can be made to suit the profile of the stack, access to and from the weather deck can be hazardous to personnel, regardless of the number of containers in the stack;

c) the use of pilot ladders is limited to lengths of 9 m and so, if the stack is three containers or more high and the means of access is by pilot ladder, it may cause problems for the ship operators;

d) the safety of personnel working on top of the deck stack must be provided for by lifelines, handholds, etc.; and

e) the container roof is not strong enough to support landing helicopters and is seldom entirely rigid. It will often be covered by greasy/moist deposits rendering winching operations extremely dangerous. The stack surface is also criss-crossed with linear gaps between the container rows and bays.

1.5.3.9 *Gas carriers*

1.5.3.9.1 Although the design criteria may differ radically between the two categories of liquified gas carrier and even between different types of ship in the same category, the general provisions for helicopter operations are common to both. The potential hazards inherent in conducting helicopter operations involving gas carriers must be clearly recognized and the owner's prerogative to protect the ship by refusing to permit routine helicopter operations must be respected. However, this does not preclude helicopter operations to gas carriers when the express consent of both the owner and the master has been obtained.

1.5.3.9.2 The major problem with regard to helicopter operations to gas carriers is the almost invariable lack of clear deck space available for the operating areas, coupled with the extreme vulnerability to damage of the deck installations and the consequent difficulty of controlling any ensuing fire. Thus it must be apparent that most gas carriers will be unable to provide a suitable clear space in the cargo area or forecastle head to provide for helicopter operations. The only suitable safe place would be the poop deck. This area is advantageous due to its remoteness from the cargo tank area, but also has the disadvantages mentioned in 1.5.1.5. In addition there is a requirement to protect the accommodation area against the potential hazards of a helicopter accident (burning fuel and flying debris).

1.5.3.9.3 If a ship is provided with a purpose built helideck, specially designed to alleviate these problems, then the poop deck represents the optimum position for a FATO. Therefore, it is strongly suggested that gas carriers should not require helicopter operations to take place unless such a helideck is provided.

1.5.3.10 *Dry cargo ships*

1.5.3.10.1 It is unlikely that the majority of general cargo ships, including modern ships of relatively large size, will be able to meet even the minimum requirements for a winching area. Their design is such that numerous tall obstacles in the form of deck houses and cargo handling gear severely limit the clear deck space available and afford little scope for the provision of a clear approach to any operating area provisionally selected. Cargo handling gear is normally stowed across the hatches in a fore and aft direction when not in use and therefore precludes the siting of winching zones on the hatch tops. It is possible that some of the larger, modern ships fitted with cranes may be capable of luffing the crane jibs and swinging them athwartships, thereby facilitating provision of a winching area either on the hatch tops or on the main deck adjacent to the hatch, with a large part of the manoeuvring area extending over the ship's side. This procedure, however, is not recommended for ships fitted with derricks due to the inherent difficulty of securing derricks adequately when luffing vertically.

1.5.3.10.2 The possibility outlined in 1.5.3.10.1 is very likely to be removed by the present trend for cargo ships to carry containers both on the hatch tops and the main deck, but gives rise to problems of safe access to and from the operating area. In the event that containers are not carried and a suitable winching area can be located on the hatch tops, it should be noted that hatch covers on general cargo ships, whether they are end-stowing or slab design, are invariably flat and therefore present a suitable clear zone for winching operations.

Chapter 2

PHYSICAL CHARACTERISTICS

2.1 SURFACE-LEVEL HELIPORTS

Note.— The following specifications are for surface-level land heliports (except where specified).

2.1.1 Final approach and take-off areas

2.1.1.1 A surface-level heliport shall be provided with at least one FATO.

Note.— A FATO may be located on or near a runway strip or taxiway strip.

2.1.1.2 The dimensions of a FATO shall be:

a) for a heliport intended to be used by performance class 1 helicopters, as prescribed in the helicopter flight manual except that, in the absence of width specifications, the width shall be not less than 1.5 times the over-all length/width, whichever is the greater, of the longest/widest helicopter the heliport is intended to serve;

b) for a water heliport intended to be used by performance class 1 helicopters, as prescribed in a) above, plus 10 per cent;

c) for a heliport intended to be used by performance class 2 and 3 helicopters, of sufficient size and shape to contain an area within which can be drawn a circle of diameter not less than 1.5 times the over-all length/width, whichever is the greater, of the longest/widest helicopter the heliport is intended to serve; and

d) for a water heliport intended to be used by performance class 2 and 3 helicopters, of sufficient size to contain an area within which can be drawn a circle of diameter not less than two times the over-all length/width, whichever is the greater, of the longest/widest helicopter the heliport is intended to serve.

2.1.1.3 The over-all slope in any direction on the FATO shall not exceed 3 per cent. No portion of a FATO shall have a slope exceeding:

a) 5 per cent where the heliport is intended to be used by performance class 1 helicopters; and

b) 7 per cent where the heliport is intended to be used by performance class 2 and 3 helicopters.

2.1.1.4 The surface of the FATO shall:

a) be resistant to the effects of downwash;

b) be free of irregularities that would adversely affect the take-off or landing of helicopters; and

c) have bearing strength sufficient to accommodate a rejected take-off by performance class 1 helicopters.

2.1.1.5 The FATO should provide ground effect.

2.1.2 Helicopter clearways

2.1.2.1 A helicopter carrying out a take-off in instrument meteorological conditions or an overshoot in IMC following a baulked landing/missed approach may need to accelerate in level flight close to the ground in order to achieve its safe climbing speed.

2.1.2.2 In order that this manoeuvre may be accomplished with maximum safety, it will be necessary to ensure that there are no objects in the probable path of the helicopter which may endanger its safety, and a helicopter clearway shall be established.

2.1.2.3 A helicopter clearway shall commence at the upwind end of the FATO, including the rejected take-off area, and continue until the first upstanding obstacle, excluding lightweight, frangible objects. If the presence of such an obstacle unduly restricts the distance for the helicopter clearway, it must be removed.

2.1.2.4 All mobile objects shall be removed from the area whose surface may be land or may be water provided the helicopters using the heliport are equipped with suitable flotation gear. Marshy or boggy ground is not recommended in the event that an emergency landing may be necessary.

2.1.2.5 The width of a helicopter clearway should be not less than that of the associated safety area.

2.1.2.6 The ground in a helicopter clearway should not project above a plane having an upward slope of 3 per cent, the lower limit of this plane being a horizontal line which is located on the periphery of the FATO.

2.1.3 Touchdown and lift-off areas (TLOFs)

2.1.3.1 Whenever it is intended that the undercarriage of a helicopter will actually touch down on the surface of a heliport or leave the surface to achieve a hover, a touchdown and lift-off area shall be provided. Such an area may form part of the FATO or it may be a discrete separate area more suitable to withstanding the mass of the helicopter, for example, or it may be part of a helicopter stand, in isolation or on a helicopter apron.

2.1.3.2 A touchdown and lift-off area may be any shape but shall be of sufficient size to contain a circle of diameter 1.5 times the length or width of the undercarriage, whichever is the greater, of the largest helicopter the area is intended to serve.

2.1.3.3 Slopes on a TLOF shall be sufficient to prevent accumulation of water on the surface of the area, but shall not exceed 2 per cent in any direction.

2.1.3.4 When siting a discrete TLOF it should be ensured that there are no obstacles such as hangars or other structures in the immediate vicinity that might cause helicopter control difficulties through turbulence or which could present a hazard when manoeuvring in cross-wind conditions.

2.1.3.5 Level, well drained ground will suffice for the area, but it must be free from any obstacles, loose stones or any other loose articles that could be stirred up by rotor downwash. It should be kept clear of snow or ice unless the helicopters are equipped for such operations.

2.1.3.6 If the area is to be used in all weather conditions it would be advisable to pave the area of the TLOF. If vehicles are likely to approach the TLOF, especially for loading or unloading freight or for refuelling, consideration should be given to paving the whole area that might be used. If refuelling is carried out on the TLOF, any spilt fuel should be removed immediately.

2.1.3.7 The bearing strength of the surface of the TLOF should be sufficient to withstand the dynamic loading imposed by the heaviest and/or largest helicopter for which the area is intended. The dynamic load due to impact on landing should cover a normal landing with a rate of descent of 1.8 m/s (6 ft/s). The impact load is equal to 1.5 times the maximum take-off weight of the helicopter.

2.1.4 Safety areas

2.1.4.1 A FATO shall be surrounded by a safety area.

2.1.4.2 The purpose of a safety area is to:

a) reduce the risk of damage to a helicopter caused to move off the FATO by the effect of turbulence or cross-wind, mislanding or mishandling; and

b) protect helicopters flying over the area during landing, missed approach or take-off by providing an area which is cleared of all obstacles except small, frangible objects which, because of their function, must be located on the area.

2.1.4.3 A safety area surrounding a FATO intended to be used in visual meteorological conditions (VMC) shall extend outwards from the periphery of the FATO for a distance of at least 3 m or 0.25 times the over-all length/width, whichever is the greater, of the longest/widest helicopter the area is intended to serve.

Note.— The larger of the two alternatives given above shall always be applied.

2.1.4.4 A safety area surrounding a FATO intended to be used by helicopter operations in instrument meteorological conditions (IMC) shall extend:

a) laterally to a distance of at least 45 m on each side of the centre line; and

b) longitudinally to a distance of at least 60 m beyond the ends of the FATO.

Note.— See Figure 2-1.

2.1.4.5 No fixed object shall be permitted on a safety area, except for frangibly mounted objects which, because of their function, must be located on the area. No mobile object shall be permitted on a safety area during helicopter operations.

2.1.4.6 Objects whose functions require them to be located on the safety area shall not exceed a height of 25 cm when located along the edge of the FATO nor penetrate a plane originating at a height of 25 cm above the edge of the FATO and sloping upwards and outwards from the edge of the FATO at a gradient of 5 per cent.

2.1.4.7 The surface of the safety area shall not exceed an upward slope of 4 per cent outwards from the edge of the FATO.

2.1.4.8 The surface of the safety area abutting the FATO shall be continuous with the FATO and the whole of the safety area shall be treated to prevent loose stones and any other flying debris caused by rotor downwash.

2.1.5 Helicopter ground taxiways

2.1.5.1 A helicopter ground taxiway is intended to permit the surface movement of a wheeled helicopter under its own power. The specifications for taxiways, taxiway shoulders and taxiway strips included in Annex 14, Volume I, are equally applicable to helicopters as modified below. When a taxiway is intended for use by aeroplanes and helicopters, the provisions for taxiways and helicopter ground taxiways will be examined and the more stringent requirements will be applied.

2.1.5.2 The width of a helicopter ground taxiway shall not be less than:

Helicopter main gear span	*Helicopter ground taxiway width*
Up to but not including 4.5 m	7.5 m
4.5 m up to but not including 6 m	10.5 m
6 m up to but not including 10 m	15 m
10 m and over	20 m

2.1.5.3 The separation distance between a helicopter ground taxiway and another helicopter ground taxiway, an air taxiway, an object or helicopter stand shall not be less than the appropriate dimension specified in Table 2-1.

2.1.5.4 The longitudinal slope of a helicopter ground taxiway shall not exceed 3 per cent.

2.1.5.5 A helicopter ground taxiway should be capable of withstanding the traffic of such helicopters that the helicopter ground taxiway is intended to serve.

2.1.5.6 A helicopter ground taxiway should be provided with shoulders that extend symmetrically on each side of the helicopter ground taxiway for at least one half the greatest over-all width of the widest helicopter that the helicopter ground taxiway is intended to serve.

2.1.5.7 The helicopter ground taxiway and its shoulders shall provide rapid drainage but the transverse slope shall not exceed 2 per cent.

2.1.5.8 The surface of a helicopter ground taxiway should be resistant to the effects of the rotor downwash.

2.1.6 Air taxiways

2.1.6.1 An air taxiway is intended to permit the movement of a helicopter above the surface at a height normally associated with ground effect and at a ground speed less than 37 km/h (20 kt).

2.1.6.2 The choice between providing a helicopter ground taxiway or an air taxiway, where one or the other is required, will mainly depend upon:

a) the nature of the surface of the ground;

b) the fact that the width of an air taxiway would be considerably greater than the width of a helicopter ground taxiway;

c) the effects of turbulence from any adjacent structures on the control of helicopters;

d) any possible conflict between aeroplanes and helicopters; and

e) the type of helicopter undercarriage, i.e. wheels or skids.

2.1.6.3 After considering the various factors it may be decided to provide both facilities but, bearing in mind that a helicopter using an air taxiway will remain in the ground cushion, that is, close to the ground, and the consequent effect of rotor downwash, an air taxiway should not be located immediately above a helicopter ground taxiway, if the two areas are to be used concurrently.

2.1.6.4 The width of an air taxiway shall be at least two times the greatest over-all width of the helicopters that the air taxiway is intended to serve.

2.1.6.5 The surface of the ground beneath an air taxiway shall:

a) be resistant to the effects of rotor downwash; and

b) be suitable for emergency landings.

2.1.6.6 The surface of the ground beneath an air taxiway should provide ground effect.

2.1.6.7 The transverse slope of the surface of the ground beneath an air taxiway should not exceed 10 per cent and the longitudinal slope should not exceed 7 per cent. In any event, the slopes should not exceed the slope landing limitations of the helicopters the air taxiway is intended to serve.

2.1.6.8 The separation distance between an air taxiway and another air taxiway, a helicopter ground taxiway, an object or a helicopter stand shall not be less than the appropriate dimension in Table 2-1.

Table 2-1. Helicopter ground taxiway and air taxiway separation distances (expressed in multiples of greatest over-all width of helicopter — with rotors turning)

Facility	*Helicopter ground taxiway*	*Air taxiway*	*Object*	*Helicopter stand*
Helicopter ground taxiway	2 (between edges)	4 (between centre lines)	1 (edge to object)	2 (between edges)
Air taxiway	4 (between centre lines)	4 (between centre lines)	1½ (centre line to object)	4 (centre line to edge)

2.1.7 Air transit routes

2.1.7.1 Ground air taxiing by helicopters are essentially slow manoeuvres and can prove to be economically and operationally embarrassing at an airport, to helicopter and aeroplane operators alike. Therefore, when helicopters are required to move between widely spaced locations on an airport or aerodrome, it is desirable to provide air transit routes along which the helicopter can fly more quickly while maintaining a safe manoeuvre capability.

2.1.7.2 An air transit route is intended to permit the movement of a helicopter above the surface, normally at a height not above 30 m (100 ft) above ground level and at ground speeds exceeding 37 km/h (20 kt).

2.1.7.3 Air transit routes, however, require comparatively large amounts of airspace (widths of up to 200 m at night), which must be kept clear of all obstacles as well as corresponding areas of ground below them, which must be suitable and of sufficient bearing strength to permit safe emergency landings.

2.1.7.4 The width of an air transit route shall not be less than:

a) *for operations by day only,* 7.0 times the largest rotor diameter of the helicopters for which the air transit route is intended; and

b) *for operations at night,* 10.0 times the largest rotor diameter of the helicopters for which the air transit route is intended.

2.1.7.5 Any variation in the direction of the centre line of an air transit route shall not exceed 120° and shall be designed so as not to necessitate a turn of radius less than 270 m.

2.1.7.6 Air transit routes are to be selected so as to permit autorotative or one-engine-inoperative landings such that, as a minimum requirement, injury to persons on the ground or water, or damage to property are minimized.

2.1.8 Aprons

2.1.8.1 The specifications for aprons included in Chapter 3 of Annex 14, Volume I, are equally applicable to heliports as modified herewith.

2.1.8.2 The slope in any direction on a helicopter stand shall not exceed 2 per cent.

2.1.8.3 The minimum clearance between a helicopter using a helicopter stand and an object or any aircraft on another stand shall not be less than half the greatest over-all width of the helicopters that the stand is intended to serve.

2.1.8.4 Where simultaneous hover operations are to be provided for, the separation distance of 4 times the greatest over-all width of helicopter, with rotors turning, between centre points of the relevant stands are to be applied.

2.1.8.5 A helicopter stand shall be of sufficient size to contain a circle of diameter of at least the largest over-all dimension of the largest helicopter the stand is expected to serve.

2.1.9 Provision of a final approach and take-off area in relation to a runway or taxiway

2.1.9.1 To facilitate the operation of helicopters at an aerodrome, provision should be made for a FATO separate from the aeroplane take-off and landing areas, although aeroplanes and helicopters may share a common runway in low visibility conditions so that the helicopter can use a runway ILS as an aid in its final approach. The FATO should be so located as to:

a) provide adequate separation from aeroplane traffic patterns and so avoid conflict in take-off and landing operations;

b) avoid areas where the jet efflux from aeroplane engines, especially at take-off or break-away power, is likely to cause high turbulence or severely degrade the ground cushion below a helicopter in the hover;

c) avoid areas where vortex wake generated by landing aeroplanes is likely to exist and affect helicopters either in the final approach phase or in the hover adjacent to the runway;

d) avoid the rotor downwash from large and heavy helicopters affecting light aeroplanes parked on an apron or on a taxiway during the approach or departure of the helicopter; and

e) avoid the risk of debris being ingested by the engines of other aircraft as a result of the debris being blown about by rotor downwash.

2.1.9.2 To some extent these problems can be avoided through Air Traffic Control and aerodrome management procedures. However, at busy aerodromes with a large amount of helicopter traffic, it is important that the design and layout of the aerodrome take these problems into account to ensure that they are reduced to a minimum.

2.1.9.3 Those parts of the runway where vortex wake generation is likely to be greatest are in the threshold and touchdown zone areas while the aeroplane wings are still generating lift and also at the point of take-off as the aeroplane rotates and becomes airborne with high power applied. For these reasons, it is undesirable that a FATO should be located opposite the thresholds or touchdown zones of a runway or within a runway strip.

2.1.9.4 At taxiway intersections and aircraft holding points serving runways, aeroplanes are likely to use higher power in the turn when taxiing and when moving forward from a stationary position. Thus it is considered undesirable to locate a FATO adjacent to these areas as well.

2.1.9.5 Special attention should be given in preparing the surface around the FATO to resist erosion from jet engine exhausts and rotor downwash and so minimize the risk of ingestion of loose surface materials by both aeroplane and helicopter engines.

2.1.9.6 It will usually be necessary to locate a touchdown and lift-off area separate from the FATO on a discrete helicopter stand or helicopter apron where helicopters can embark and disembark passengers or load/unload cargo. It should be located so as to:

a) be as close as possible to passenger check-in areas to avoid lengthy walking distances; and

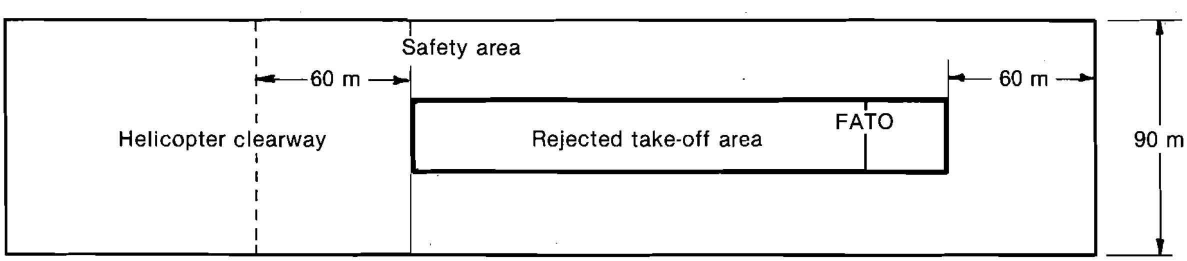


Figure 2-1. Safety area for instrument FATO

b) avoid as much as possible the mixing of aeroplanes and helicopters on aprons or on taxiways because of the relatively slow speeds at which the helicopters ground taxi and to avoid conflict between aeroplanes on taxiways and helicopters using air taxiways.

2.1.9.7 Where a FATO is located near a runway or taxiway, and simultaneous VMC operations are planned, the separation distance between the edge of a runway or taxiway and the edge of a FATO shall not be less than the appropriate dimension in Table 2-2.

Table 2-2. FATO minimum separation distance

If aeroplane mass and/or helicopter mass are:	*Distance between FATO edge and runway edge or taxiway edge*
up to but not including 2 720 kg	60 m
2 720 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

2.2 ELEVATED HELIPORTS

2.2.1 Final approach and take-off area and touchdown and lift-off area

2.2.1.1 On elevated heliports, it is presumed that the FATO and the touchdown and lift-off area will be coincidental.

2.2.1.2 An elevated heliport shall be provided with at least one FATO.

2.2.1.3 The dimensions of the FATO shall be:

a) for a heliport intended to be used by performance class 1 helicopters, as prescribed in the helicopter flight manual except that, in the absence of width specifications, the width shall be not less than 1.5 times the over-all length/width, whichever is the greater, of the longest/widest helicopter the heliport is intended to serve; and

b) for a heliport intended to be used by performance class 2 helicopters, of sufficient size and shape to contain an area within which can be drawn a circle of diameter not less than 1.5 times the over-all length/width, whichever is the greater, of the longest/widest helicopter the heliport is intended to serve.

2.2.1.4 The slope requirements for elevated heliports should conform to the requirements for surface level heliports, specified in 2.1.1.3.

2.2.1.5 The FATO shall be capable of withstanding the traffic of helicopters the heliport is intended to serve. Design considerations shall take into account additional loading resulting from the presence of personnel, snow, freight, refuelling and fire fighting equipment, etc. (see Chapter 1, 1.3.2.1).

2.2.2 Safety area

2.2.2.1 The FATO shall be surrounded by a safety area.

2.2.2.2 The safety area shall extend outwards from the periphery of the FATO for a distance of at least 3 m or 0.25 times the over-all length/width, whichever is the greater, of the longest/widest helicopter intended to use the elevated heliport.

2.2.2.3 No fixed object shall be permitted on the safety area, except for frangibly designed objects which, because of their function, must be located on the area. No mobile object shall be permitted on the safety area during helicopter operations.

2.2.2.4 Objects whose function require them to be located on the safety area shall not exceed a height of 25 cm when located along the edges of the FATO nor penetrate a plane originating at a height of 25 cm above the edge of the FATO and sloping upwards and outwards from the edges of the FATO at a gradient of 5 per cent.

2.2.2.5 The surface of the safety area shall not exceed an upward slope of 4 per cent outwards from the edge of the FATO.

2.2.2.6 The surface of the safety area abutting the FATO shall be continuous with the FATO and be capable of supporting, without structural damage, the helicopters that the heliport is intended to serve.

2.3 HELIDECKS ON OFFSHORE INSTALLATIONS

2.3.1 Final approach and take-off area and touchdown and lift-off area

2.3.1.1 On helidecks it is presumed that the FATO and the TLOF will be coincidental.

2.3.1.2 A helideck shall be provided with at least one FATO.

2.3.1.3 The size of the FATO is, of necessity, a compromise for offshore operations where space is so limited. The area must provide sufficient space for the landing gear configuration, sufficient area to provide a helpful "ground cushion" effect from the rotor downwash, sufficient room for passengers and crew to alight or embark, sufficient clearance from obstacles for both main and tail rotors and, finally, some margin to allow for touchdown position inaccuracies caused by crew mismanagement, helicopter control difficulties or helicopter equipment failures.

2.3.1.4 It becomes inevitable, therefore, that the touchdown and lift-off area should be coincident with the FATO and, in consequence of the considerations stated in 2.3.1.3, the minimum safe size of the FATO for a single main rotor helicopter or side-by-side twin rotor helicopter is deemed to be an area which can accommodate a circle whose diameter is not less than the largest dimension over-all, when rotors are turning, of the largest helicopter the helideck is intended to serve. This dimension is known by the symbol D and shall be applied.

2.3.1.5 A variation to this criterion becomes necessary when omnidirectional landings are planned for helicopters having tandem main rotors. In such cases the minimum safe size shall be an area which can contain a circle whose diameter is not less than 0.9 times D. An extension of the obstacle-free surface is also necessary (see Chapter 3, 3.2.3.9 b)). Where this diameter circle cannot be met, the FATO may encompass a rectangular shape whose smaller sides shall be not less than 0.75D and whose longer sides shall be not less than 0.9D. In such a configuration, bi-directional operations only will be permitted and then only in the direction of the 0.9D dimension.

2.3.1.6 No fixed object shall be permitted around the edge of the FATO except for frangibly designed objects which, because of their function, must be located thereon.

2.3.1.7 Objects whose function require them to be located on the edge of the FATO shall not exceed a height of 25 cm.

2.3.1.8 The helideck shall have an over-all coating of non-slip material and all paint markings on the surface of the helideck shall be made of non-skid materials. A wide variety of suitable materials are available commercially and information on which materials would be best applied in particular cases should be obtained through the appropriate authority in each individual State.

2.3.1.9 To ensure adequate drainage on fixed installations, the helideck should be laid to a fall or be cambered to prevent rainfall or fuel spillage from remaining on the FATO. Such falls or cambers should be approximately 1:100 and should be designed to drain the liquids away from the main structure. The deflection of the helideck surface, due to loads from a helicopter at rest, should not modify the FATO drainage system to the extent of allowing spilled fuel to remain on the FATO. A system of guttering or a slightly raised kerb should be provided around the perimeter of the helideck to prevent spilled fuel from falling on to other parts of the installation and to conduct the spillage to a safe storage or disposal place.

2.3.1.10 A tautly stretched rope netting should preferably be provided to aid the landing of helicopters, particularly those with wheeled undercarriages, in adverse weather conditions. A net will considerably assist in the stability of the helicopter on the helideck in conditions of high wind, water, snow and ice. Because of the possible adverse effects of skid tips becoming enmeshed in the netting, the use of netting on helidecks intended solely for the use of helicopters with skid type undercarriages should be left to the discretion of the particular helicopter operator using the helideck.

2.3.1.11 It is preferable that the net be manufactured from 20 mm diameter sisal, with a maximum mesh size of 200 mm. The mesh should be knotted and not threaded. The rope should be secured every 1.5 m around the FATO perimeter and tensioned to at least 2 225 N. Netting made of other materials will be acceptable provided it is strong enough to withstand the wear and tear of helicopter operations and the rigours of regional weather conditions, and provided it will not damage helicopter undercarriages or become an unacceptable hazard to the safety of personnel moving across the net.

2.3.1.12 There are normally three sizes of landing net and they should be selected according to the type of helicopter for which the FATO is intended. Table 2-3 gives guidance on which size of net is considered appropriate to a particular size of helicopter.

Table 2-3. Landing net size

Helicopter over-all length	*Landing net size*	
Up to 15 m	Small	6 m x 6 m
15-20 m	Medium	12 m x 12 m
Over 20 m	Large	15 m x 15 m

2.3.1.13 Sufficient tie-down points should be provided, so located and of such strength and construction as to be suitable for securing the helicopter types for which the helideck is designed. They should be fitted flush with the surface of the FATO to obviate damage to tyres or skids. Advice should be sought from helicopter operators on the correct configurations of tie-down points required for their particular type of helicopter.

2.3.1.14 Where the helideck is constructed in the form of a grating, the underdeck design shall be such that ground effect is not reduced.

2.4 HELIDECKS ON SHIPS

2.4.1 When helicopter operating areas, other than winching areas, are provided in the bow or stern of a ship or are purpose-built above the ship's structure, they shall be regarded as helidecks and the criteria given in 2.3 shall apply.

2.4.2 Final approach and take-off area and touchdown and lift-off area

2.4.2.1 On heliports, other than those regarded as helidecks, located on ships, it is presumed that the FATO and the TLOF will be coincidental.

2.4.2.2 Shipboard heliports shall be provided with at least one FATO.

2.4.2.3 Because of the limited space available, the FATO is required to be of circular shape only, such shape demanding the least amount of space whilst satisfying the minimum size required consistent with safety.

2.4.2.4 The restricted space available results in a smaller size of FATO having to be accepted compared with an on-shore heliport. Thus the minimum size acceptable shall be a circle whose diameter is not less than 1.0 times the largest dimension, when rotors are turning, of the largest helicopter expected to use the FATO (D).

2.4.2.5 The FATO shall have an over-all coating of non-slip material and all paint markings on the surface of the FATO shall be made from non-skid materials. A wide variety of suitable materials are available commercially and information on which materials would be best applied in particular cases should be obtained through the appropriate authority in each individual State.

2.4.2.6 The structural strength of the surface of the FATO shall be the same as for an on-shore elevated heliport given in 1.3.

2.4.2.7 Although the effect of temperature increases is not likely to pose a problem, the complex effects of the ship's motion and of the wind over the highly obstructed environment can cause considerable turbulence for both ship's side and amidships located heliports. These effects should be assessed and the helicopter operator advised accordingly.

Chapter 3

OBSTACLE RESTRICTION AND REMOVAL

3.1 OBSTACLE LIMITATION SURFACES AND SECTORS

3.1.1 General

3.1.1.1 The objectives of the specifications in Chapter 4 of Annex 14, Volume II are to define the airspace around heliports to be maintained free from obstacles so as to permit the intended helicopter operations at the heliports to be conducted safely and to prevent the heliports becoming unusable by the growth of obstacles around them. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

3.1.1.2 In order to safeguard a helicopter during its approach to the FATO and in its climb after take-off, it is necessary to establish an approach surface and a take-off climb surface through which no obstacle is permitted to project, for each approach and take-off climb path designated as serving the FATO.

3.1.1.3 The minimum dimensions required for such surfaces will vary considerably and, in the main, depend upon:

a) the size of helicopter, its climbing speed and rate of climb, particularly when one engine is inoperative, its approach speed and rate of descent on the final approach, and its controllability at such speeds; and

b) the conditions under which the approaches and take-off climbs are made, e.g. whether in VMC or IMC and, if in IMC, whether the approaches are non-precision or precision instrument approaches.

3.1.1.4 Once such surfaces are established, it may become necessary to remove existing obstacles which project through the surface and restrict the erection of new structures which would become obstacles. Mobile objects, such as cranes, lorries, boats and trains, may be regarded as obstacles at certain times, in which case it would be necessary to delay helicopter operations until the obstacle is clear of the surface.

3.1.2 Approach surface

3.1.2.1 *Description.* An inclined plane or a combination of planes sloping upwards from the end of the safety area and centred on a line passing through the centre of the FATO (see Figure 3-1).

3.1.2.2 *Characteristics.* The limits of an approach surface shall comprise:

a) an inner edge, horizontal and equal in length to the minimum specified width 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 and:

   1) for other than a precision approach FATO, diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO;

   2) for a precision approach FATO, diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO, to a specified height above FATO, and then diverging uniformly at a specified rate to a specified final width and continuing thereafter at that width for the remaining length of the approach surface; and

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

3.1.2.3 The elevation of the inner edge shall be the elevation of the safety area at the point on the inner edge that is intersected by the centre line of the approach surface.

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

3.1.2.5 Areas between the inner edge of the approach surface and the safety area, if any, shall have the same characteristics as the safety area, since it would be unacceptable for such areas to have characteristics that were below the standards of either of the adjoining surfaces.

3.1.2.6 Figure 3-7 illustrates such areas by shading the relevant portions, but these are, of necessity, shown only for the basic configurations of FATO and safety area and are not drawn to scale. However, the planned direction of the approach surface may not be located in line with, or at a convenient 45° to the centreline of the FATO. Furthermore, the FATO, and thus the safety area, may be of irregular shape or be much larger than one which can only just accommodate a circle of the minimum specified dimensions. Finally, if a heliport contains one FATO only, there are required to be at least two approach surfaces, set at least 150° apart.

3.1.2.7 The problems involved with such deviations from the basic configurations are:

a) where the inner edge shall be located; and

b) the shapes and sizes of the shaded areas may vary considerably.

3.1.2.8 To satisfy 3.1.2.7 a), one should imagine a circle located as near as possible to the approach edge(s) of the safety area, and whose diameter is equal to the minimum specified total width of the safety area. The inner edge shall then be tangential to the perimeter of the circle with its mid-point located on the perimeter (see Figure 3-8).

3.1.2.9 To identify the shaded areas, if any, it is necessary to consider their side edges as extending from the ends of the inner edge to points where they meet the perimeter of the circle mentioned in 3.1.2.8, tangentially. The shaded areas will then be bounded by these side edges, the inner edge and the edges of the safety area.

3.1.2.10 Where more than one approach surface is provided it may be necessary to imagine more than one circle within the safety area, each located at the appropriate approach end of the safety area. This will always be necessary if the heliport is to accommodate performance class 1 helicopters (see Figure 3-9).

3.1.2.11 For heliports used by performance class 2 and 3 helicopters, it is intended that approach paths be selected so as to permit safe forced landings or one-engine-inoperative landings such that, as a minimum requirement, injury to persons on the ground or water or damage to property are minimized. Provisions for forced landing areas are expected to minimize risk of injury to the occupants of the helicopter. The most critical helicopter type for which the heliport is intended and the ambient conditions will be factors in determining the suitability of such areas.

3.1.3 Transitional surface

3.1.3.1 *General*

3.1.3.1.1 There are numerous reasons why a pilot would be obliged to discontinue an approach and to carry out a missed approach procedure prior to making another attempt. In visual meteorological conditions a missed approach would not present a problem since a pilot could see and manoeuvre to avoid any obstacles in the intended flight path. In IMC, however, the pilot is less likely to be able to see the obstacles and the missed approach could become a hazardous manoeuvre.

3.1.3.1.2 For the safety of a helicopter which becomes displaced from the centre line while executing the missed approach procedure in IMC, a transitional surface must be provided, although it is not a necessity under non-instrument (visual) conditions.

3.1.3.2 *Description.* A complex surface along the side of the safety area and part of the side of the approach surface, that slopes upwards and outwards to the inner horizontal surface, or to a pre-determined height (see Figure 3-1).

3.1.3.3 *Characteristics.* The limits of a transitional surface shall comprise:

a) a lower edge beginning at the intersection of the side of the approach area with the inner horizontal surface, or beginning at a specified height above the lower edge when an inner horizontal surface is not provided, and extending down the side of the approach surface to the inner edge of the approach surface and from there along the length of the side of the safety area parallel to the centre line of the FATO; and

b) an upper edge located in the plane of the inner horizontal surface, or at a specified height above the lower edge when an inner horizontal surface is not provided.

3.1.3.4 The elevation of a point on the lower edge shall be:

a) along the side of the approach surface — equal to the elevation of the approach surface at that point; and

b) along the safety area — equal to the elevation of the centre line of the FATO opposite that point.

3.1.3.5 As a result of b) above, the transitional surface along the safety area will be curved if the profile of the FATO is curved, or a plane if the profile is a straight line. The intersection of the transitional surface with the inner horizontal surface, or upper edge when an inner horizontal surface is not provided, will also be a curved or a straight line depending on the profile of the FATO.

3.1.3.6 The slope of the transitional surface shall be measured in a vertical plane at right angles to the centre line of the FATO.

3.1.4 Inner horizontal surface

3.1.4.1 Many non-precision instrument approach procedures require that, at the end of the approach, a circular manoeuvre, or a manoeuvre of some other pattern, be carried out prior to the final landing. These manoeuvres would, of course, be carried out visually but are nevertheless regarded as part of the non-precision instrument approach procedure and the safety of the helicopter throughout the manoeuvre must be provided for. Thus, where such procedures are required, and if straight-in, non-precision instrument approaches are not available at both ends of the FATO, an inner horizontal surface should be provided.

3.1.4.2 *Description.* A circular surface located in a horizontal plane above a FATO and its environs (see Figure 3-1).

3.1.4.3 *Characteristics.* The radius of the inner horizontal surface shall be measured from the mid-point of the FATO.

3.1.4.4 The height of the inner horizontal surface shall be measured from the elevation of the lowest point on the periphery of the FATO.

3.1.5 Conical surface

3.1.5.1 To ensure, in conjunction with the inner horizontal surface, safe visual manoeuvring in the vicinity of the heliport and in order to facilitate practicable and efficient instrument approach procedures, a conical surface is required.

3.1.5.2 The conical surface also represents the level above which consideration should be given to the control of new obstacles and the removal or the conspicuous marking and lighting of existing obstacles.

3.1.5.3 *Description.* A surface sloping upwards and outwards from the periphery of the inner horizontal surface, or outer limit of the transitional surface if an inner horizontal surface is not provided (see Figure 3-1).

3.1.5.4 *Characteristics.* The limits of the conical surface shall comprise:

a) a lower edge coincident with the periphery of the inner horizontal surface or outer limit of the transitional surface if an inner horizontal surface is not provided; and

b) an upper edge located at a specified height above the inner horizontal surface, or outer limit of the transitional surface if an inner horizontal surface is not provided.

3.1.5.5 The slope of the conical surface shall be measured above the horizontal.

3.1.6 Take-off climb surface

3.1.6.1 During the take-off climb manoeuvre, far more power is required from the helicopter engines than is required during the descent on an approach to the hover or landing. If, during the take-off or climb phases, one engine becomes inoperative, even greater power is required from the remaining engine. However, in many helicopter types, the single engine is unable to supply the power required to sustain the best rate of climb obtainable with both engines operative, and so a lower rate of climb and lower angle of climb must be accepted.

3.1.6.2 In instrument meteorological conditions, it is also often necessary for a helicopter to accelerate further than is required to achieve its minimum single-engine speed in order to attain the required speed for flight in IMC.

3.1.6.3 As a result of these factors, plus the need to allow for the more difficult control in handling when flying with sole reference to instruments, it is necessary to apply modified dimensions for the take-off climb surface compared with the approach surface.

3.1.6.4 In many instances, the presence of permanent, high obstacles such as radio masts, buildings or areas of high ground may preclude the provision of the required take-off climb/approach surfaces for a straight take-off climb or approach for a planned FATO, whereas the criteria required for the surfaces would be feasible if a curved flight path which avoided the obstacles was established.

3.1.6.5 For the same reason, or perhaps because the ground beneath the required straight surface is marshy or boggy, it may be necessary to vary the direction of the flight paths over ground which is suitable and provides sufficient areas to provide for safe emergency landings to be carried out by performance class 2 or 3 helicopters.

3.1.6.6 In selecting such curved flight paths, and they may require more than one turn in their total length, careful consideration must be given to the performance and handling characteristics of the helicopter, the avoidance of undue discomfort to the helicopter passengers and the need to minimize noise nuisance by avoiding the overflying of populated areas.

3.1.6.7 Practical studies have shown that for an average speed of 60 kt and a bank angle of 20°, helicopter handling and passenger comfort are within acceptable tolerances. These parameters lead to a radius of turn of 270 m, which should be regarded as a minimum. If one parameter employed varies, then the other parameter must be correspondingly varied to maintain the radius of turn at no less than this minimum. Furthermore, it is considered to be undesirable to commence a turn after take-off or complete a turn on the final approach below 30 m (100 ft) for performance class 2 or 3 helicopters or 15 m (50 ft) for performance class 1 helicopters, since the rate of climb is reduced or the rate of descent is increased, as appropriate, in a turn unless additional power is applied.

3.1.6.8 It is barely conceivable that a heliport designed for the use of performance class 1 helicopters would not also be used by performance class 2 and 3 helicopters. Therefore, the normal minimum height for the commencement/completion of a turn should be 30 m (100 ft) for all performance classes of helicopter.

3.1.6.9 In instrument meteorological conditions it will almost certainly not be possible for a pilot to identify the boundaries or centre line of curved take-off climb or approach paths unless full guidance is provided. Therefore, in the absence of such guidance, curved take-off and approach paths should be restricted to non-instrument operations only.

3.1.6.10 *Description.* 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 Figure 3-1).

3.1.6.11 *Characteristics.* The limits of a take-off climb surface shall comprise:

a) an inner edge horizontal and equal in length to the minimum specified width 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 or clearway;

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 above the elevation of the FATO.

3.1.6.12 The elevation of the inner edge shall be the elevation of the safety area at the point on the inner edge that is intersected by the centre line of the take-off climb surface except that when a clearway is provided, the elevation shall be equal to the highest point on the ground on the centre line of the clearway.

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

3.1.6.14 In the case of a take-off climb surface involving a turn, the surface shall be a complex surface containing the horizontal normals to its centre line and the slope of the centre line shall be the same as that for a straight take-off climb surface. That portion of the surface between the inner edge and 30 m above the inner edge shall be straight.

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

3.1.7 Obstacle-free sector/surface — helidecks

3.1.7.1 Unlike a surface-level ground heliport, the directions of the take-off climb and approach paths are likely to be severely restricted on helidecks by the proximity of installation or vessel structure and/or equipment whose location is essential to the efficient primary operation of the installation or vessel.

3.1.7.2 It is important for helicopters landing and taking off that a headwind component is provided, particularly when considering the stronger wind speeds usually encountered over sea areas. Therefore, in order to ensure that some headwind component is provided, take-off climbs/approaches must be made available over an arc of at least 210°.

3.1.7.3 The reference point of origin for the surface of the 210° sector shall be on the periphery of the FATO at a point on the centre line of the FATO nearest to the obstacles. This will provide protection for all parts of a helicopter in transit to and from the FATO. The surface shall extend outwards for a distance compatible with the distance required by the most critical helicopter the helideck is intended to serve, to accelerate to its specified one-engine-inoperative climb speed after one engine becoming inoperative during or shortly after take-off.

3.1.7.4 The surface shall be a horizontal plane level with the elevation of the helideck except that, over an arc of 180° passing through the centre of the FATO, the surface shall be at water level, extending outwards for a distance compatible with the take-off space required for the most critical helicopter the helideck is intended to serve (see Figure 3-2).

3.1.8 Limited obstacle surface — helidecks

3.1.8.1 The dimensions of a FATO on a helideck are designed to afford the maximum possible protection for all parts of a helicopter touching down in the centre of a FATO of minimum required size. However, consideration has also to be given to the protection of the main rotor and tail rotor blades when manoeuvring to touch down into wind or when touching down further inboard than the centre of the FATO, while having regard to the proximity of items essential to the safe and efficient operation of the installation or vessel and to the helideck.

3.1.8.2 A sector is provided, therefore, in which obstacles may be permitted, provided the height of the obstacles is limited.

3.1.8.3 *Description.* A complex surface originating at the reference point for the obstacle-free sector and extending over the arc not covered by the obstacle-free sector as shown in Figures 3-4, 3-5 and 3-6 and within which the height of obstacles above the level of the FATO will be prescribed.

3.1.8.4 *Characteristics.* The limited obstacle surface shall not subtend an arc greater than a specified angle and shall be sufficient to include that area not covered by the obstacle-free sector.

3.2 OBSTACLE LIMITATION REQUIREMENTS

3.2.1 Surface level heliports

3.2.1.1 The following obstacle limitation surfaces shall be established for a precision approach FATO:

a) take-off climb surface;

b) approach surface;

c) transitional surfaces; and

d) conical surface.

3.2.1.2 The following obstacle limitation surfaces shall be established for a non-precision approach FATO:

a) take-off climb surface;

b) approach surface;

c) transitional surfaces; and

d) conical surface if an inner horizontal surface is not provided.

3.2.1.3 It is recommended that the following obstacle limitation surfaces should be established for a non-precision approach FATO:

a) inner horizontal surface; and

b) conical surface.

3.2.1.4 The following obstacle limitation surfaces shall be established for a non-instrument FATO:

a) take-off climb surface; and

b) approach surface.

3.2.1.5 *Straight approach surface for non-instrument FATO*

3.2.1.5.1 To simplify the complexities of the dimensions of the approach surface, it may be divided into three sections. In the first section, the lateral edges of the surface diverge from the direction of the centre line by 10° each side for daylight operations and 15° each side for night operations. The increase in divergence at night is to allow for the fact that any obstacles close to the centre line may be less readily discernible. The length of this section shall be 245 m, which will permit the helicopter to avoid unsafe combinations of height and airspeed whilst accelerating.

3.2.1.5.2 The width of the surface at the end of the first section should then be 49 m plus the length of the inner edge. The slope of the surface up to this point shall be 8 per cent, which also takes into account those combinations of height and airspeed to be avoided.

3.2.1.5.3 The divergence for the second section shall continue the same as for the first section and shall extend until the over-all width of the surface has reached a distance, for daylight operations, which is equal to 7 times the rotor diameter of the largest helicopter for which the surface is intended to be used. This is considered to be an adequate width to enable the helicopter to carry out its manoeuvres to maintain the centre line of approach. For the same reason as given in 3.2.1.5.1, this over-all width is increased to 10 times the rotor diameter for night operations.

3.2.1.5.4 Having accounted for those combinations of height and airspeed to be avoided, the slope of the second section can be increased to 12.5 per cent, thus permitting more flexibility in the height to which obstacles can be accepted.

3.2.1.5.5 Throughout the third and final section, the width of the surface remains constant at the 7 or 10 rotor diameter dimensions, as appropriate, thus the lateral sides of the surface are no longer required to diverge.

3.2.1.5.6 The slope throughout this section can be increased again to 15 per cent and continues until the surface reaches a height of 150 m (500 ft) above the elevation of the inner edge. At this point, the surface ends at a horizontal outer edge, perpendicular to the centre line of the approach surface.

3.2.1.6 *Straight approach surface for non-precision instrument approach FATO*

3.2.1.6.1 The inner edge of the surface shall be the same as for a non-instrument approach FATO except that, to allow for possible less precise helicopter control when flying solely by reference to instruments, the length of the inner edge shall be 90 m and shall be located 60 m from the downwind end of the FATO.

3.2.1.6.2 The dimensions of the approach surface are much less complicated in this case and can be described using one section only.

3.2.1.6.3 The lateral side edges shall diverge from the direction of the centre line by 16 per cent for a total length along the centre line of 2 500 m to the outer edge. This permits the pilot ample space to settle on the centre line in spite of the non-precise nature of the procedure.

3.2.1.6.4 The horizontal outer edge thus has a width of 890 m and the slope of the surface is required to be 3.33 per cent (1:30) throughout its length.

3.2.1.7 *Straight approach surface for precision instrument approach FATO*

3.2.1.7.1 The characteristics and dimension of the horizontal inner edge are exactly the same as for a non-precision instrument approach FATO.

3.2.1.7.2 The characteristics for the precision approach surface are much more complex than for a non-instrument approach surface and are best dealt with in two planes, firstly in plan and secondly in profile:

a) to allow space for the helicopter pilot to attain the approach centre line and maintain the approach heading while flying solely by reference to instruments, the most practicable over-all width of the approach surface is deemed to be 1 800 m;

b) as the helicopter nears the FATO, directional control becomes more critical and so the width may be progressively reduced. In the final stage, as the helicopter decelerates, its low-speed handling characteristics in particular render this possible, especially since by now the helicopter can usually be flown with reference to the heliport lighting;

c) to assist in planning the approach surface, and bearing in mind the possible proximity of obstacles, this reduction in width is made in two stages according to the height above the elevation of the

FATO. This height may be variable, depending upon the operational procedures selected by the helicopter operator. Therefore, Annex 14, Volume II, Chapter 4, Table 4-2, specifies four heights above FATO at which the divergence of the sides of the surface will change;

d) the lateral side edges of the surface diverge on each side from the ends of the inner edge at 25 per cent from the direction of the centre line to the specified height which is a maximum of 30 m (100 ft) above the elevation of the FATO. From that point the divergence will be 15 per cent on each side until the over-all width reaches 1 800 m, at which point the sides shall remain parallel to each other until a total distance of 10 000 m is reached; and

e) the surface terminates at a horizontal outer edge whose length is 1 800 m.

3.2.1.7.3 The helicopter has the capability to make approaches at a variety of angles of descent even when it is being flown solely by reference to instruments. This can be of value when the environment at a particular heliport, such as in a city centre, requires that a steeper than usual approach be made. However, this capability of the helicopter should not be used by a heliport designer merely because existing obstacles limit the air space available or to reduce heliport real estate. The steeper approaches are uncomfortable for pilots flying in IMC conditions, and especially so for the helicopter passengers. Therefore, whenever possible, heliport designers should plan for the shallower approach angles. An approach angle of 3° is usually the most desirable approach.

3.2.1.7.4 In profile, the dimensions of the approach surface which permit a 3° approach are as follows and are divided into three sections:

a) in the first section, the slope of the surface is 2.5 per cent for a horizontal distance of 3 000 m;

b) in the second section, the slope is increased to 3 per cent for a further distance of 2 500 m; and

c) in the third and final section, the surface remains level for 4 500 m, giving a distance over-all of 10 000 m.

3.2.1.7.5 The dimensions of the approach surface to permit a 6° approach are as follows:

a) in the first section the slope of the surface is 5 per cent for a horizontal distance of 1 500 m;

b) in the second section the slope is increased to 6 per cent over a distance of 1 250 m; and

c) for the steeper approach, the helicopter needs a greater distance to become established on the centre line before commencing its descent and so the third section remains level for a further distance of 5 750 m, giving an over-all distance for the surface of 8 500 m.

3.2.1.8 *Transitional surface*

3.2.1.8.1 The lower edge of the transitional surface shall be along the edges of the safety area except that, where the safety area meets the inner edge of the approach surface, it shall extend along the sides of the approach surface up to the points where the approach surface and the inner horizontal surface, if provided, intersect. If no inner horizontal surface is provided, then the lower edge shall extend along the sides of the approach surface up to a height of 45 m above the elevation of the FATO.

3.2.1.8.2 From the lower edge, the surface shall slope upwards and outwards by 20 per cent (1:5) for a non-precision approach FATO and by 14.3 per cent (1:7) for a precision approach FATO until it reaches the upper edge.

3.2.1.8.3 The upper edge shall be at a height of 45 m and in the plane of the inner horizontal surface, if provided.

3.2.1.9 *Inner horizontal surface*

An inner horizontal surface shall be at a height of 45 m above the elevation of the lowest point on the edges of the FATO. It shall be circular in shape and shall extend outwards for a radius of 2 000 m centred on the mid-point of the FATO.

3.2.1.10 *Conical surface*

3.2.1.10.1 The lower edge of a conical surface shall be coincident with:

a) the perimeter of the inner horizontal surface; or

b) if an inner horizontal surface is not provided, the upper edge of the transitional surface.

3.2.1.10.2 From the lower edge, the conical surface shall slope upwards and outwards by 20 per cent (1:5) until it reaches a height of 100 m above the elevation of the FATO. Thus the depth of the surface will be 55 m.

3.2.1.11 *Take-off climb surface for non-instrument (visual) FATO*

3.2.1.11.1 The requirements for the inner edge shall be the same as for the approach surface except that the inner edge shall be located at the upwind extremity of the safety area or the end of the clearway, if provided.

3.2.1.11.2 For performance class 2 and 3 helicopters, the divergence of the lateral sides of the surface in the first section and the length, outer width and slope of the section shall be the same as for the approach surface, thus permitting the helicopter to avoid unsafe combinations of height and airspeed whilst accelerating and climbing.

3.2.1.11.3 In the second and third sectors the divergence and length of the sectors shall be the same as for the approach surface, for performance class 2 and 3 helicopters, but the slope of the surface is increased to 15 per cent in both sectors.

3.2.1.11.4 For performance class 1 helicopters, the divergence of the lateral sides in the first section is also 10 per cent for day operations and 15 per cent for night operations. The length of this section is determined by the distance required for the sides to diverge to an over-all width of 7 rotor diameters for day operations and 10 rotor diameters for night operations. The dimension of one rotor diameter shall be the diameter of the largest rotor of the helicopters for which the FATO is intended.

3.2.1.11.5 To allow for the one-engine-inoperative performance requirements of performance class 1 helicopters, the slope of the surface shall be a maximum of 4.5 per cent. It is pointed out that this slope of the surface may exceed the maximum mass one-engine-inoperative climb gradient of the helicopter but is selected as a realistic compromise for heliport planning between helicopter performance requirements and the obstacle environment. In such cases, operational limitations will need to be imposed on helicopter operations.

3.2.1.11.6 In the second and final section, for performance class 1 helicopters, the sides of the surface remain at a constant distance from each other parallel to the centre line of the surface. The slope remains at 4.5 per cent until the surface reaches a height of 150 m above the elevation of the inner edge.

3.2.1.12 *Take-off climb surface for instrument FATO*

3.2.1.12.1 The origin of the take-off climb surface shall be an inner edge which shall be horizontal and whose length is 90 m perpendicular to the centre line of the take-off climb surface. It shall be located at the upwind extremity of the safety area or at the end of the helicopter clearway if one is provided.

3.2.1.12.2 In the first section, the lateral sides of the surface diverge from the direction of the centre line by 30 per cent on each side. The length of this section is 2 850 m, by which distance the sides of the surface will have diverged to give an over-all width of 1 800 m.

3.2.1.12.3 The slope of the surface in the first section is 3.5 per cent and again the one-engine-inoperative climb gradient of some helicopters may result in limitations being imposed on helicopter operations.

3.2.1.12.4 In the second section, the sides of the surface remain parallel to the centre line at a constant width of 1 800 m and continue for a length of 1 510 m. The slope remains at 3.5 per cent for this section.

3.2.1.12.5 In the third and final section, the sides remain parallel, 1 800 m apart. The length of this section is 7 640 m but the slope is reduced to 2 per cent only. The reason for this reduction in slope over this section is that the further one goes from the FATO, the more likely one is to encounter higher, permanent obstacles, which would be unseen by the pilot in IMC and would be an extreme hazard to a helicopter flying solely on instruments with one-engine inoperative.

3.2.1.13 The slopes of the surfaces shall not be greater than, and their other dimensions not less than those specified in Figures 3-7 and 3-10 to 3-13 and Tables 3-1 to 3-4.

3.2.1.14 New objects or extensions of existing objects shall not be permitted above any of the surfaces in 3.2.1.1 to 3.2.1.4 except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

3.2.1.15 Existing objects above any of the surfaces in 3.2.1.1 to 3.2.1.4 above should, as far as practicable, be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of helicopters.

3.2.1.16 A surface level heliport shall have at least two take-off climb and approach surfaces, separated by not less than 150°.

3.2.1.17 The number and orientation of take-off climb and approach surfaces should be such that the usability factor of a heliport is not less than 95 per cent for the helicopters the heliport is intended to serve.

3.2.2 Elevated heliports

3.2.2.1 The obstacle limitation requirements for elevated heliports shall be the same as the requirements for surface level ground heliports, discussed in the preceding paragraphs of this chapter.

3.2.2.2 All height and slope dimensions shall be relative to a datum which shall be a horizontal plane whose elevation is the elevation of the elevated FATO.

3.2.2.3 An elevated heliport shall have at least two take-off climb and approach surfaces separated by not less than 150°.

3.2.3 Helidecks on offshore installations

3.2.3.1 A helideck shall have an obstacle-free sector and, where necessary, a limited obstacle sector.

3.2.3.2 The obstacle-free sector shall comprise an arc of at least 210° whose origin shall be at any point on the periphery of the D circle for single main rotor helicopter use or from the mid-point of the inboard edge of the longer side of the rectangle for tandem main rotor helicopter use.

3.2.3.3 The 210° sector shall totally enclose the FATO.

3.2.3.4 The surface of the 210° sector shall be a horizontal plane level with the elevation of the FATO, except as given below through which no obstacle shall protrude except for items essential for the operation of the helideck, such as lighting, fire fighting equipment, etc. Such essential items must be frangible and not exceed a height of 25 cm above the elevation of the surface.

3.2.3.5 Whilst these criteria will ensure that no obstacles exist *above* the level of the FATO in the take-off climb/approach area, it is necessary to consider the possibility of the helicopter losing too much height during the later stages of the approach or being unable to sustain level flight in the early stages after take-off. Accordingly, protection should be provided *below* the level of the FATO in this critical sector.

3.2.3.6 This protection should be provided over an arc of at least 180° with its point of origin at the centre of the FATO and whose bisector is the extended centre line of the FATO.

3.2.3.7 An obstacle-free surface contained in this 180° arc shall be a descending gradient at a rate of one unit horizontally to 5 units vertically, commencing at the edges of the helideck. This gradient will allow for the unavoidable protrusions of the installation structure below the helideck. From the points where the gradient reaches water level, the surface shall extend at water level for a distance compatible with the take-off space required for the most critical helicopter the helideck is intended to serve (see Figure 3-3).

3.2.3.8 No obstacles should be permitted to protrude through the surface of this 180° area except that support or maintenance vessels essential to the operation of the installation or vessel may be accepted but shall be confined to within an arc subtended from the centre of the FATO not exceeding 30°.

3.2.3.9 The limited obstacle sector shall contain a surface whose origin is the reference point of the surface of the obstacle-free sector and which subtends the arc not covered by the obstacle-free sector, that is, a maximum of 150°. The surface shall extend for a distance from the centre of the FATO of:

a) for single-main-rotor and side-by-side twin rotor helicopters, 0.62 times the over-all length of the largest helicopter for which the FATO is intended (0.62D) at a height above the elevation of the FATO of 0.05D and thence rising at a gradient of one unit vertically for each two units horizontally (1:2) to an over-all distance of 0.83D from the centre of the FATO;

b) for omnidirectional operations by tandem-main-rotor helicopters, 0.62D at the elevation of the FATO, that is, obstacle-free and thence to an over-all distance of 0.83D at a height of 0.05D above the elevation of the FATO; and

c) for bi-directional operations by tandem-main-rotor helicopters, 0.62D at a height of 1.1 m above the elevation of the FATO.

3.2.3.10 To allow some flexibility in the location of essential items in the proximity of the FATO, it is permitted to swing the limited obstacle surface by a maximum 15° in either direction when the FATO is to be used for omnidirectional operations but not for bi-directional operations by tandem-main-rotor helicopters.

3.2.3.11 The configurations of the limited obstacle surfaces are illustrated in Figures 3-4, 3-5 and 3-6.

3.2.3.12 No obstacle should be permitted to protrude through these limited obstacle surfaces. However, if this is unavoidable, the appropriate authority may agree to operations on limited headings or by smaller helicopters only.

3.2.4 Helidecks on ships

Note.— When helidecks, as defined in Chapter 1, Section 1.5, are provided on ships, the criteria for the obstacle-free and limited obstacle surfaces shall be precisely the same as those applied to helidecks on offshore installations.

3.2.4.1 *Amidships location*

3.2.4.1.1 Forward and aft of the FATO shall be two symmetrically located sectors each covering an arc of 150° with their apexes on the periphery of the D reference circle where the fore-and-aft line of the ship intersects the perimeter of the reference circle. Within the entire area enclosed by these two sectors, no objects shall be permitted which rise above the level of the FATO except those aids which are essential to the safe operation of a helicopter. Such items must be frangible and not exceed a height of 25 cm above the level of the FATO.

3.2.4.1.2 This obstacle-free area will provide a safe funnel over the deck of the ship for the helicopter to approach and take off from the FATO or fly through at low level in the event of an aborted approach or mislanding.

3.2.4.1.3 To provide further protection for a helicopter manoeuvring over or in the proximity of the FATO, rising surfaces with gradients of one unit vertically to 5 units horizontally shall be provided which extend from the entire length of the edges of the two 150° sectors. These surfaces shall each extend for a horizontal distance equal to at least the diameter of the FATO and shall not be penetrated by any obstacle (see Figure 3-14).

3.2.4.1.4 This arrangement provides for helicopters to approach and depart the FATO along two narrow funnels only, one on either side athwart the FATO. Such an arrangement also means that, in the event of a mislanding, the helicopter will be assured of a fly-out path clear of obstructions.

3.2.4.1.5 Details of all such amidships non-purpose built heliports with the obstacle environment obtaining should be submitted to the appropriate aviation authority who may wish to impose certain restrictions before granting clearance for the use of the heliport by landing helicopters.

3.2.4.2 *Ship's side location*

3.2.4.2.1 From the fore and aft mid-points of the D reference circle, an area shall extend to the ship's rail, the over-all width of which, at the ship's rail, shall be a distance of at least 1.5 times the diameter of the FATO and shall be located symmetrically about the athwartships bisector of the reference circle. Within this sector, no object shall be permitted which rises above the level of the FATO except for those aids which are essential for the safe operation of the heliport. Such items must be frangible and not exceed a height of 25 cm above the level of the FATO (see Figure 3-15).

3.2.4.2.2 The ship's rail must be collapsed or lowered below the level of the FATO along the entire width at least of the obstacle-free area during all helicopter manoeuvring but must be raised into its functional position whilst passengers are proceeding to embark or disembark the helicopter or when freight is being loaded or unloaded.

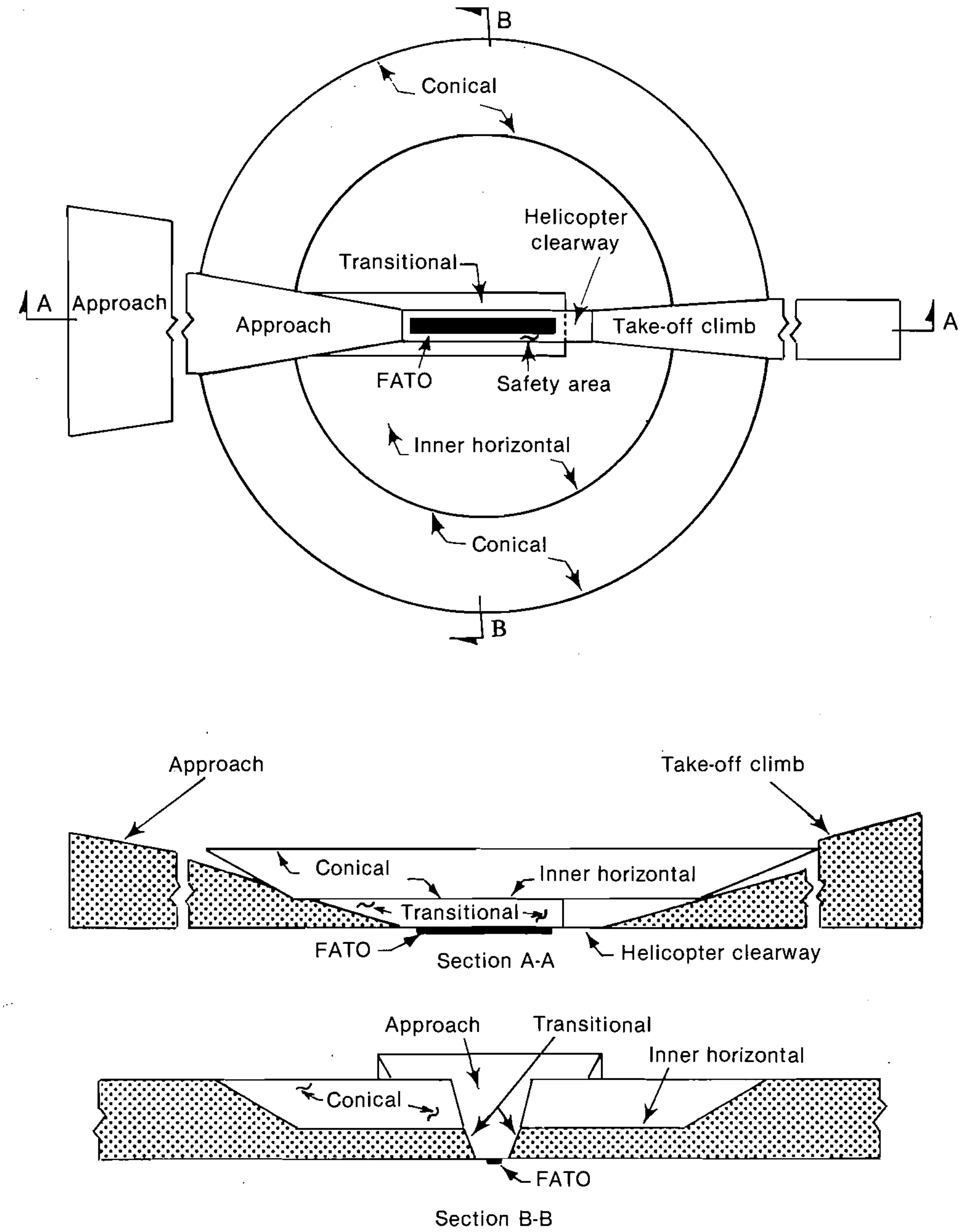
3.2.4.2.3 To protect the helicopter during the particularly difficult manoeuvres of sideways flight or hovering over the touchdown point whilst still maintaining fore-and-aft station and compensating for the wind velocity and ship's forward motion, a horizontal surface surrounding the FATO and obstacle-free areas shall be provided. This surface shall extend for at least 0.25 times the diameter of the FATO at a height of 0.05 times the diameter of the D reference circle. No obstacle shall be permitted to penetrate this surface.

3.2.4.2.4 To afford the greatest possible degree of safety for the helicopter operation it would be ideal if the ship were to stop for the duration of the operation. However this can be a time-consuming process and most frequently is inconvenient and economically unacceptable. The better alternative may be for the ship to turn into the wind. However, the turning radius of large ships, e.g. supertankers, is so great as to make the manoeuvre impractical in many cases and, in some narrow waters, quite impossible.

3.2.4.2.5 The most favoured helicopter technique to land on a ship's side heliport is for the helicopter to fly alongside the ship, level with the FATO. Then, allowing for the wind velocity, to maintain the same heading and speed as the ship, at the same time to fly sideways to a position above the FATO. This can be a very difficult manoeuvre to execute in safety and presents a particular hazard to the helicopter tail rotor.

3.2.4.2.6 Even if there is sufficient space on the ship to provide a heliport inboard of the ship's side, it is strongly desirable that the FATO be located as close to the ship's side as possible to minimize the amount of sideways flight over the ship. This will ensure the greatest degree of safety for the helicopter rotors. Ideally, the ship's rail should be tangential to the periphery of the D reference circle.

3.2.4.2.7 It is particularly important, due to the ship's motion, that the surface of the FATO be skid resistant for helicopters, and the heliport as a whole, slip resistant for personnel. The provision of a landing net is also desirable.



Note.— The figure shows the obstacle limitation surfaces at a heliport with a non-precision approach FATO and a clearway.

Figure 3-1. Obstacle limitation surfaces

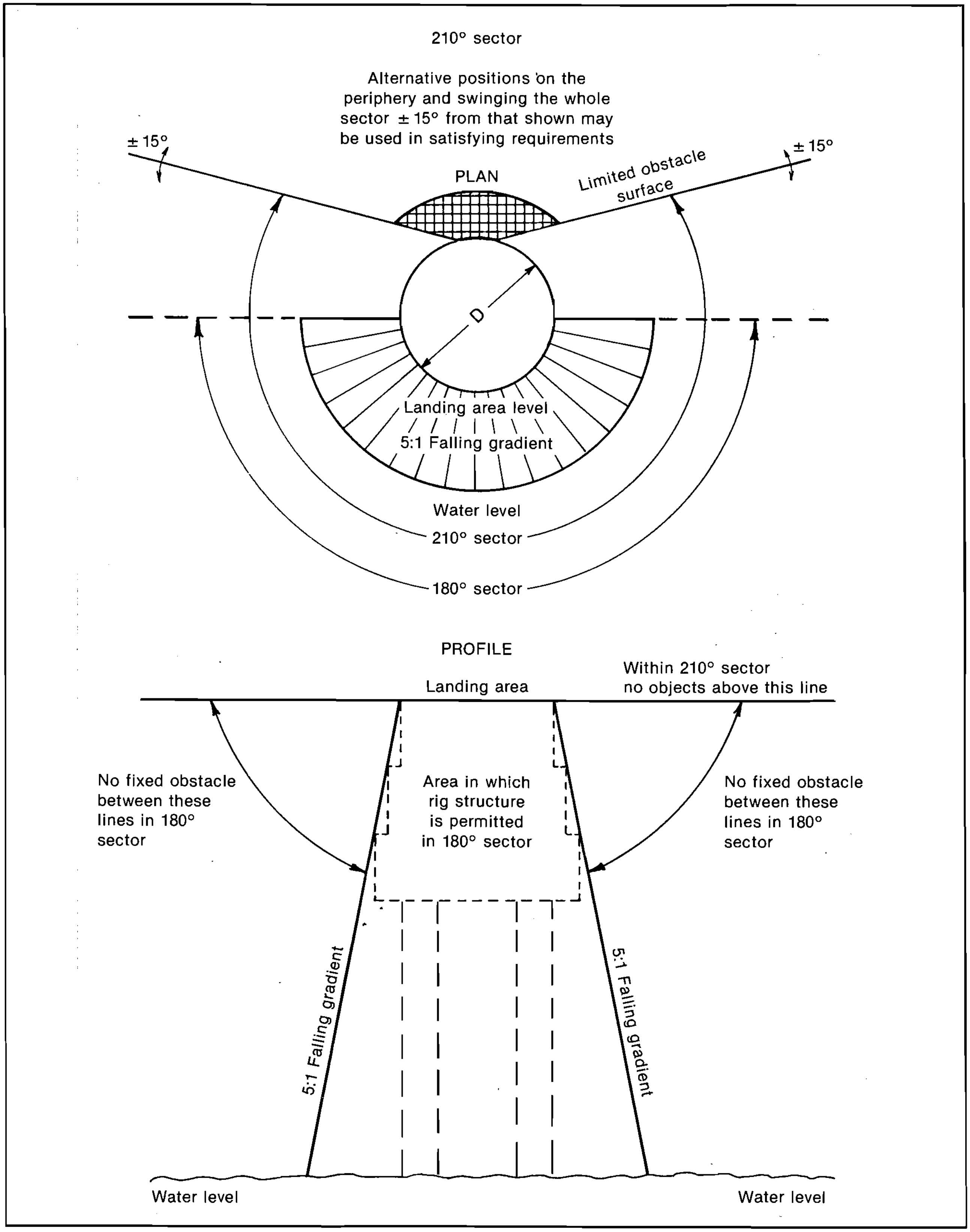
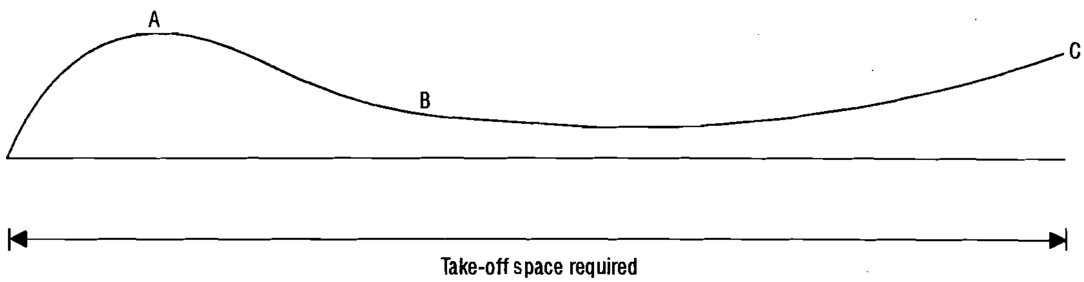


Figure 3-2. Helideck obstacle-free sector



A. Point at which one engine becomes inoperative and decision is made to continue or reject take-off.

B. Point by which one-engine inoperative speed is attained.

C. Point by which helicopter has accelerated and climbed on one engine to a minimum height of 10.7 m (35 ft) above water level.

Figure 3-3. Take-off space required

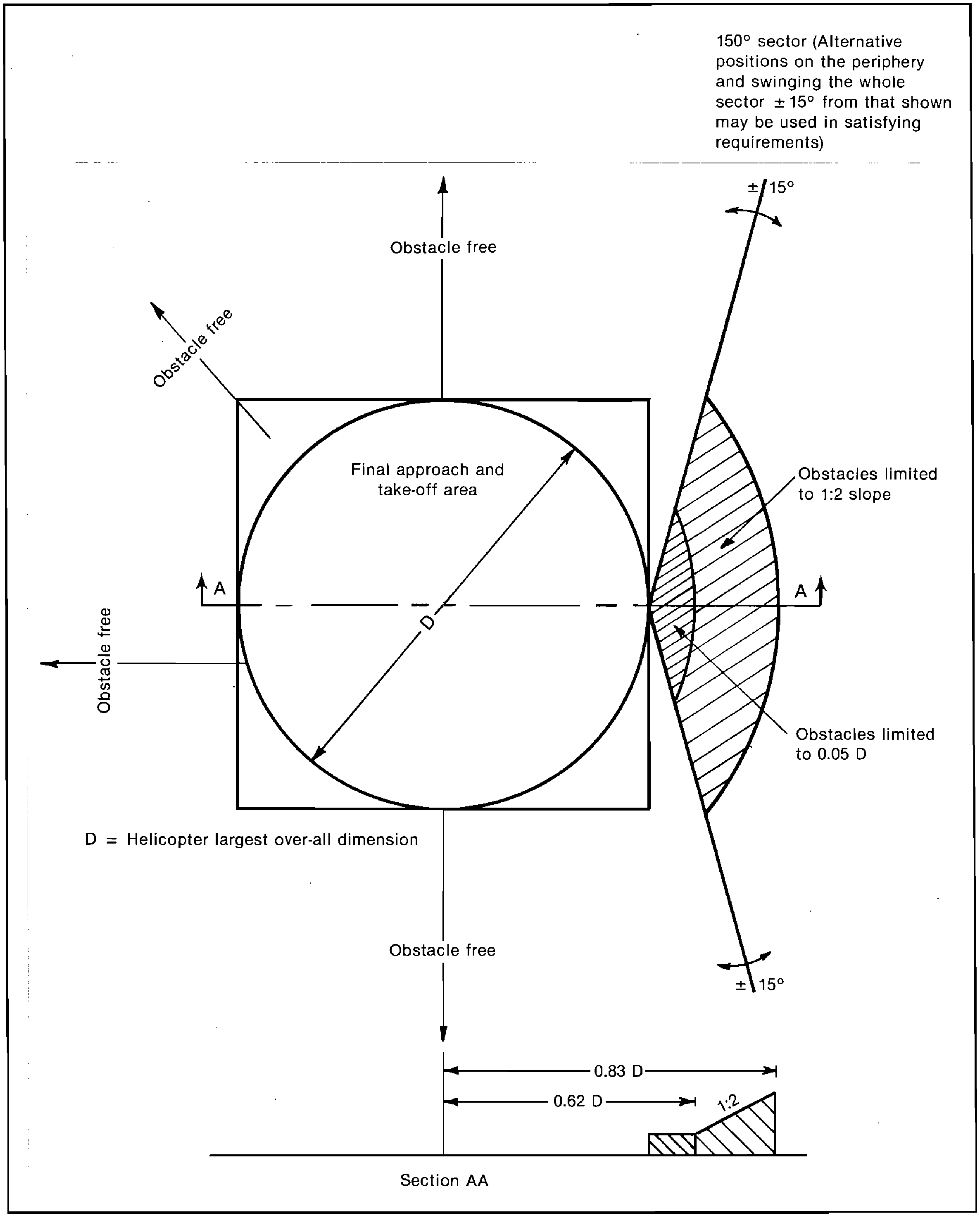


Figure 3-4. Helideck obstacle limitation sectors
Single-main-rotor and side-by-side twin rotor helicopters

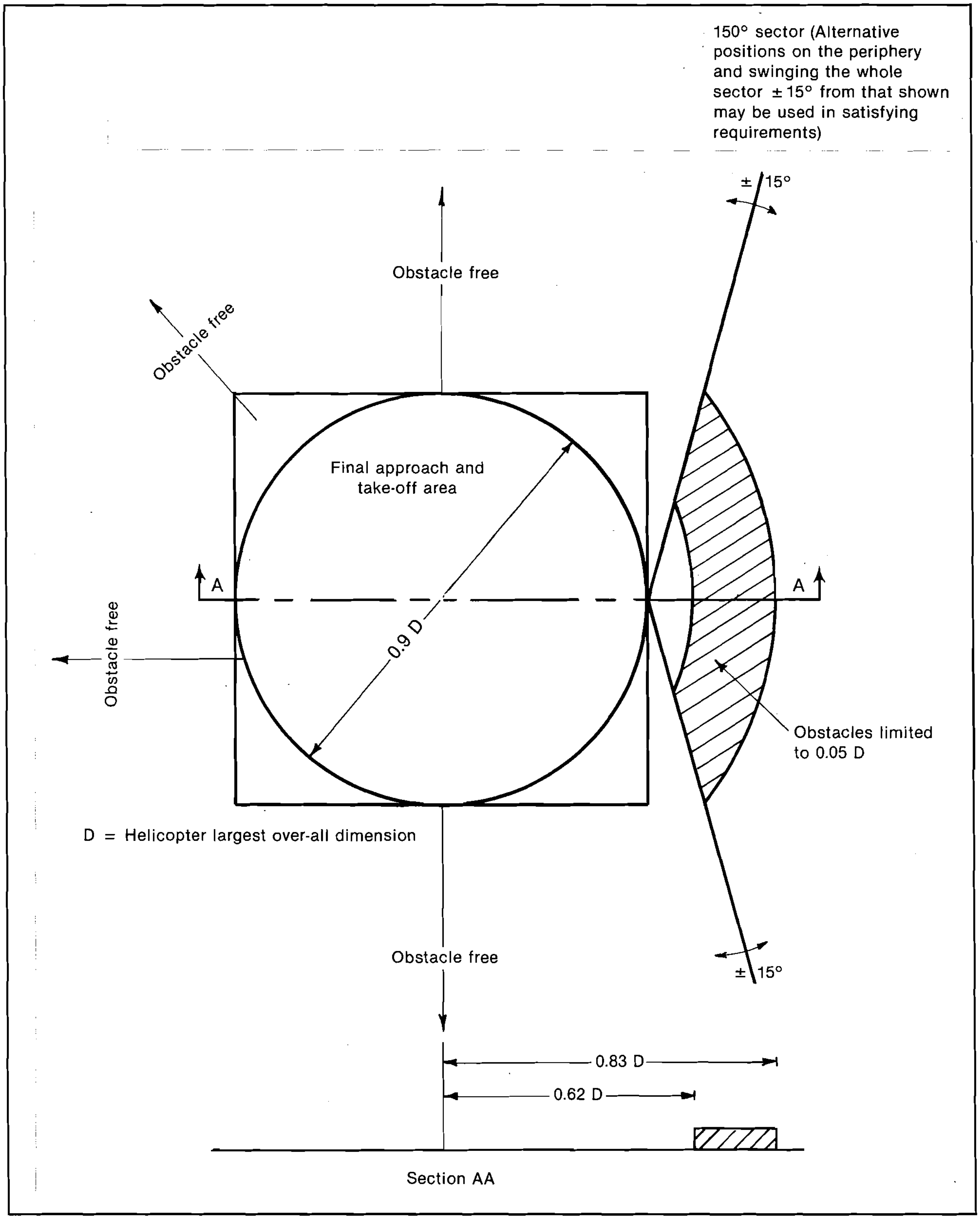


Figure 3-5. Helideck obstacle limitation sectors
Tandem-main-rotor helicopters — Omnidirectional operations

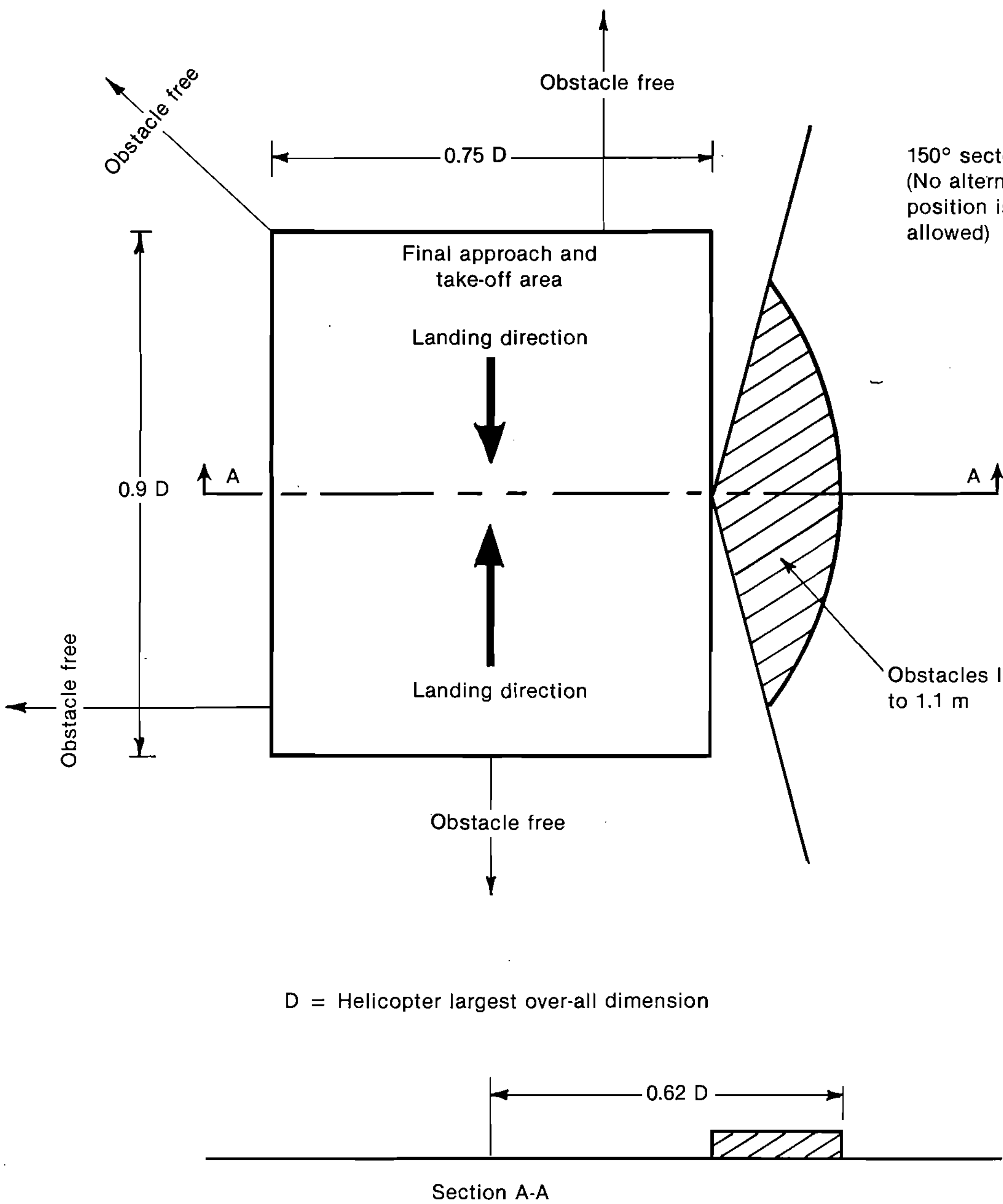
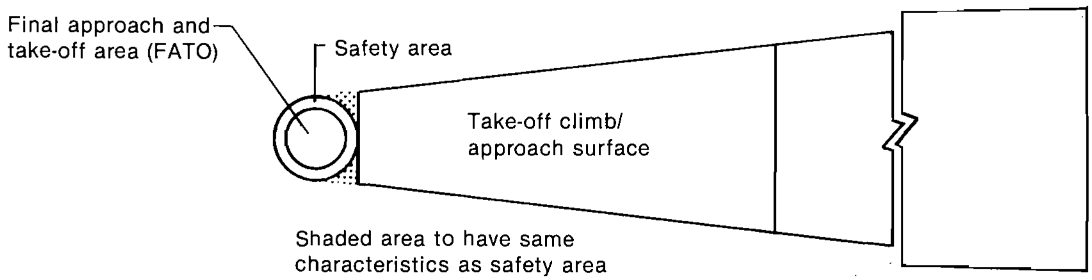
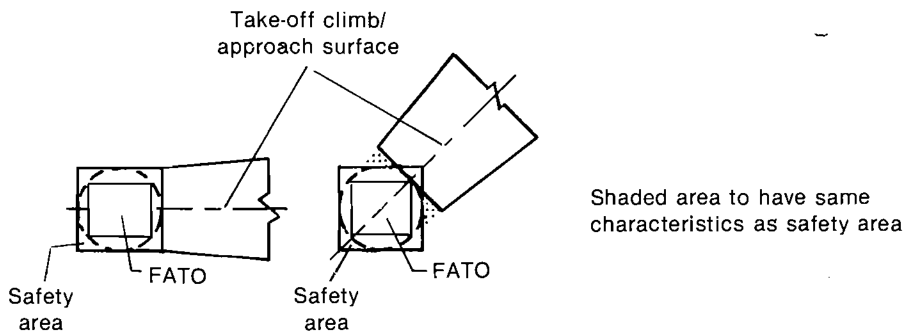


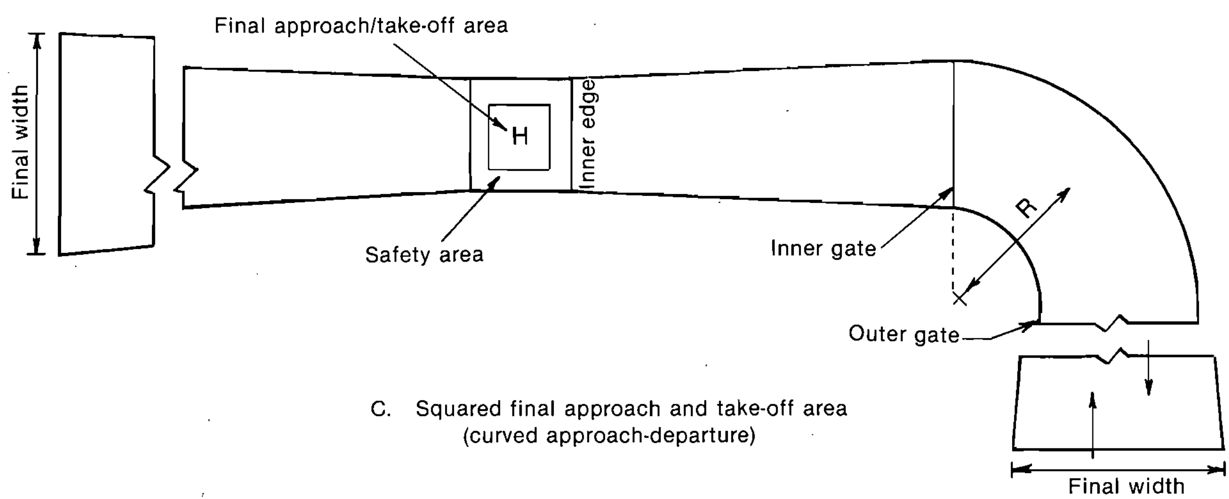
Figure 3-6. Helideck obstacle limitation sectors
Tandem-main-rotor helicopters — Bi-directional operations



A. Circular final approach and take-off area
(straight approach-departure)



B. Squared final approach and take-off area
(straight approach-departure)



C. Squared final approach and take-off area
(curved approach-departure)

Figure 3-7. Take-off climb/approach surface (non-instrument FATO)

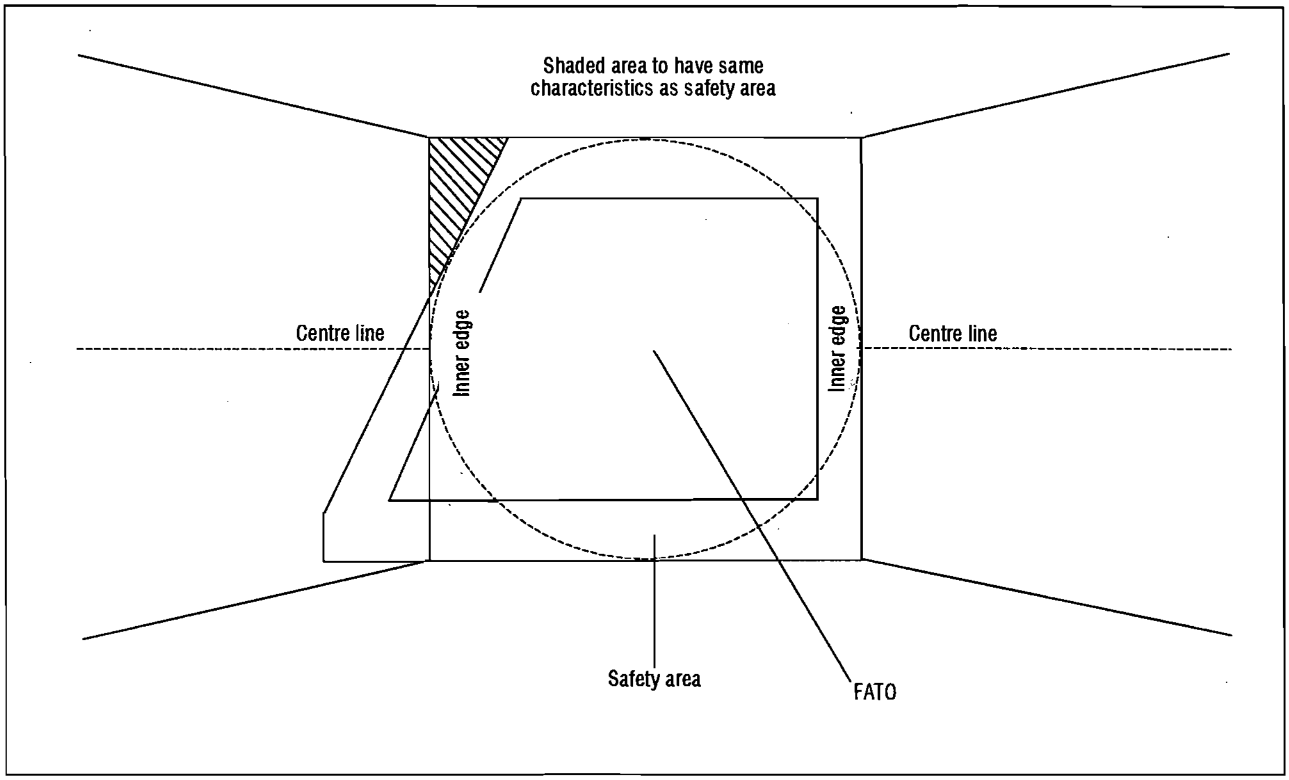


Figure 3-8. Take-off climb/approach surfaces (irregular shaped non-instrument FATO)

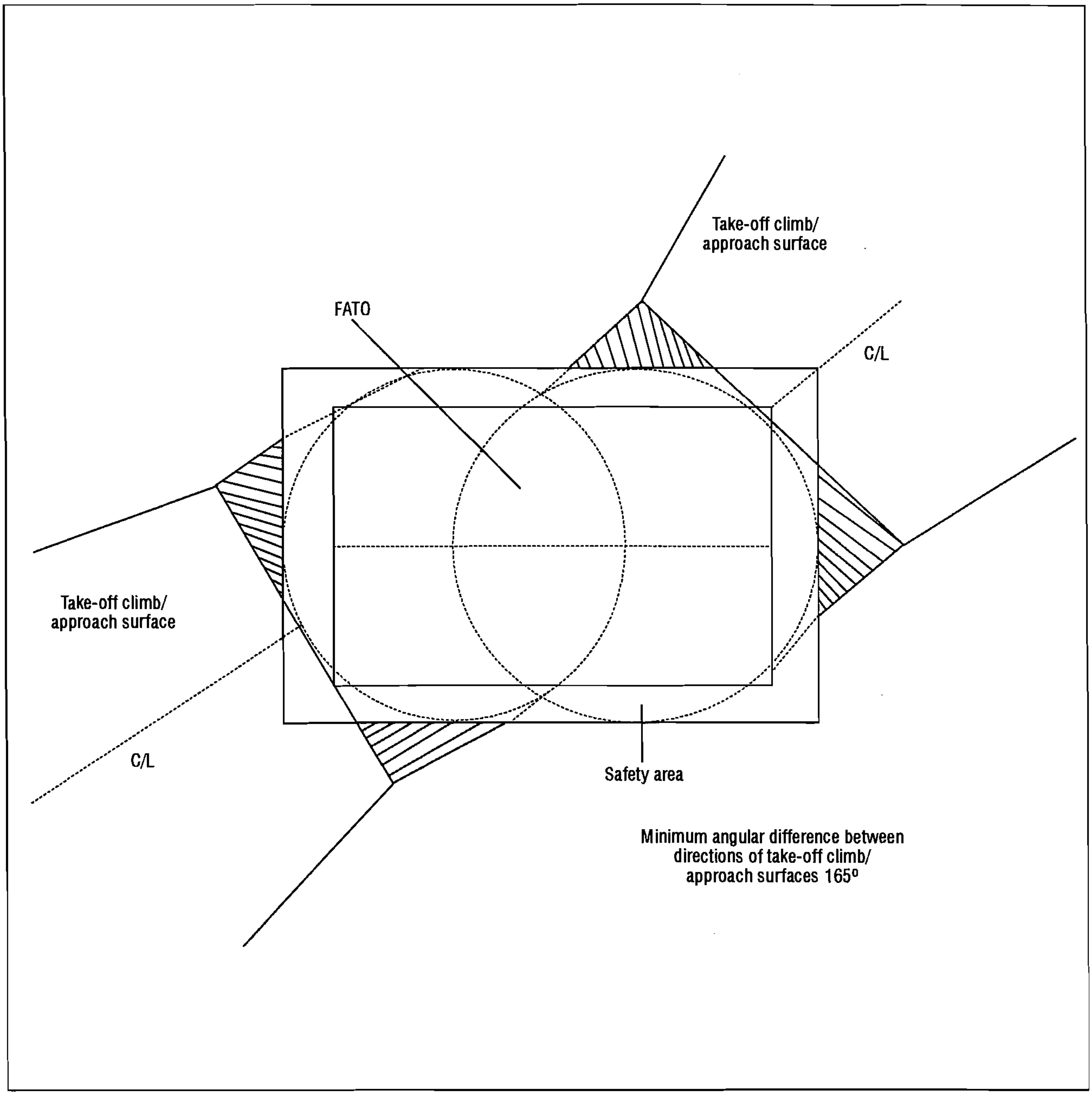


Figure 3-9. Take-off climb/approach surfaces (larger than minimum specified non-instrument FATO)

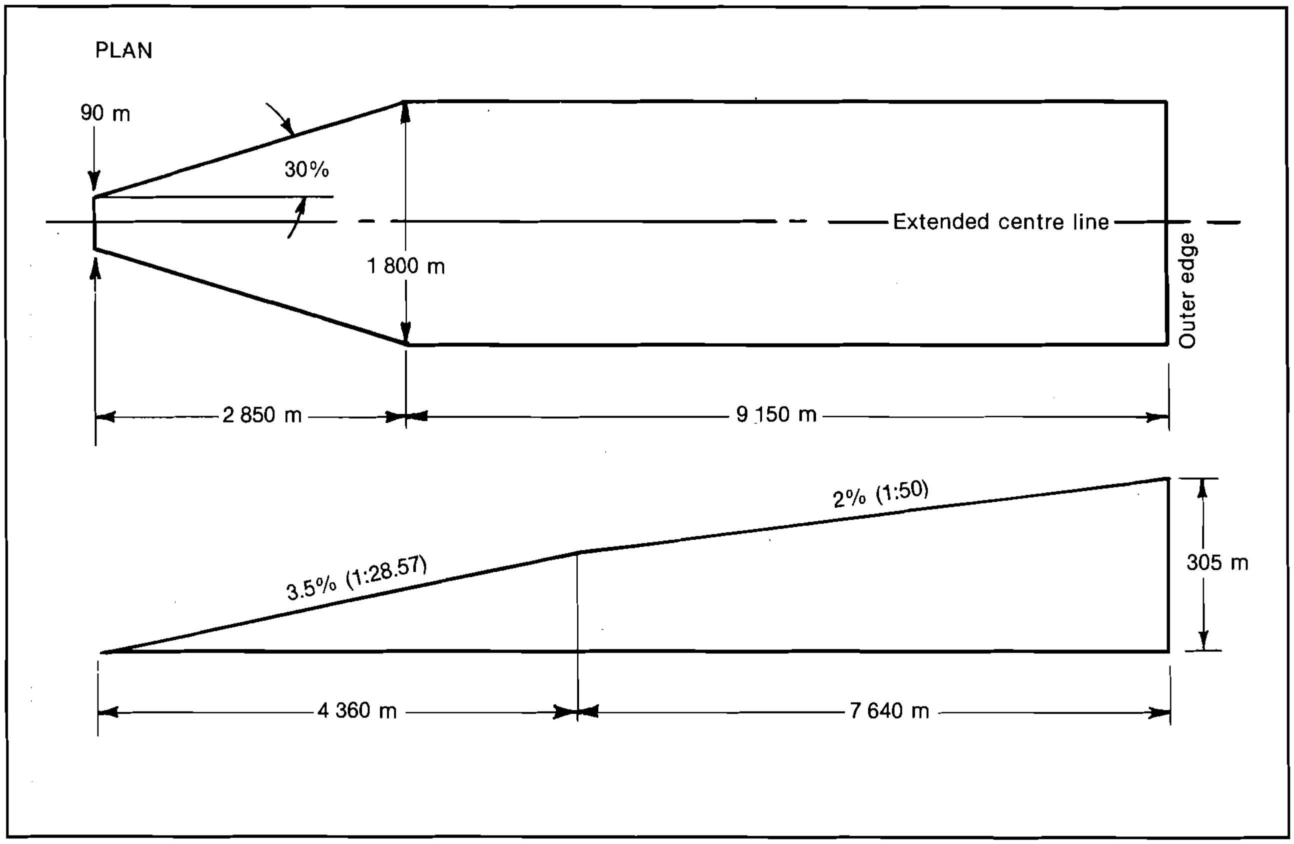


Figure 3-10. Take-off climb surface for instrument FATO

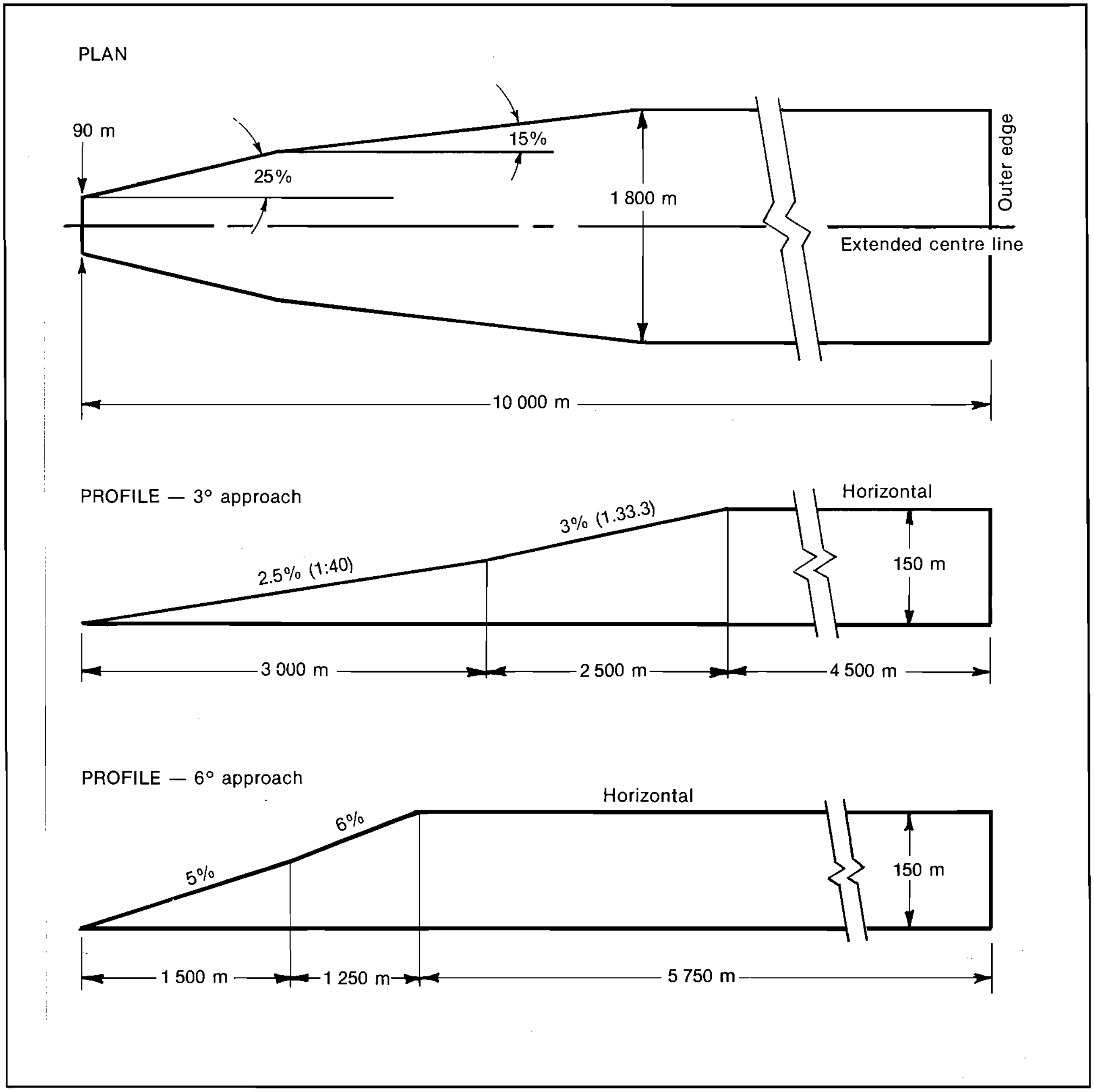


Figure 3-11. Approach surface for precision approach FATO

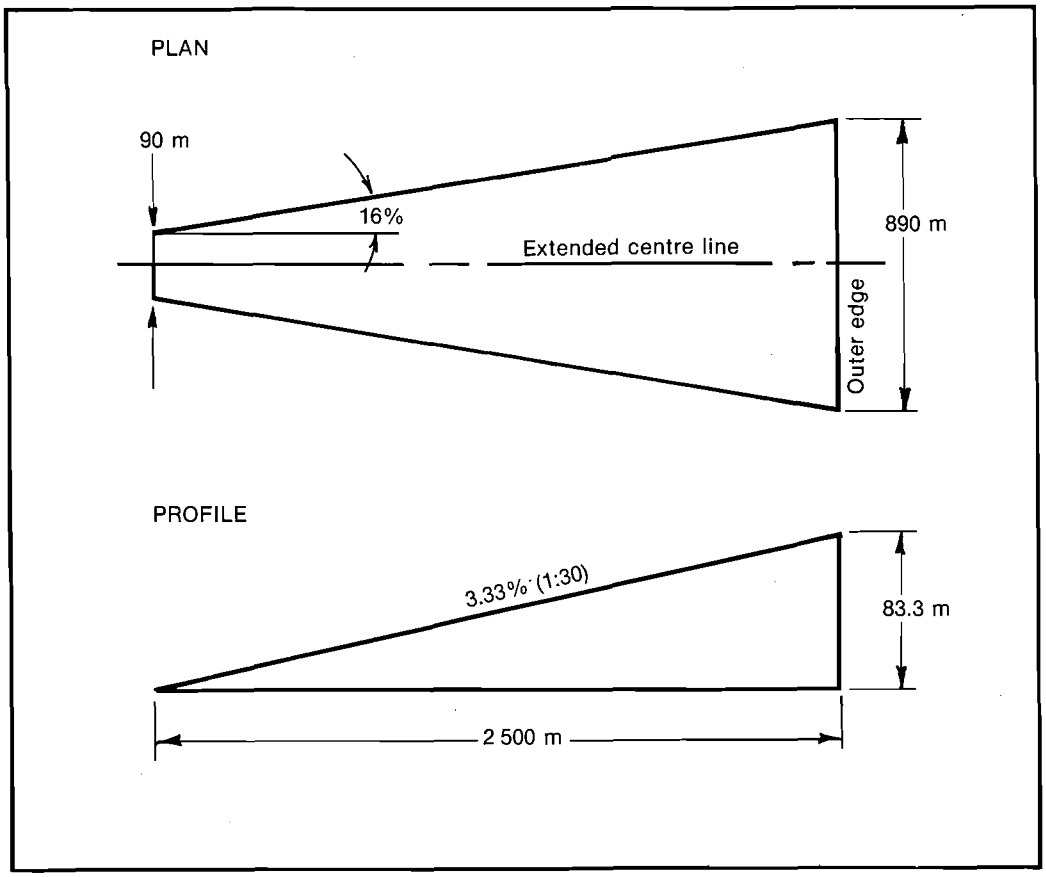


Figure 3-12. Approach surface for non-precision approach FATO

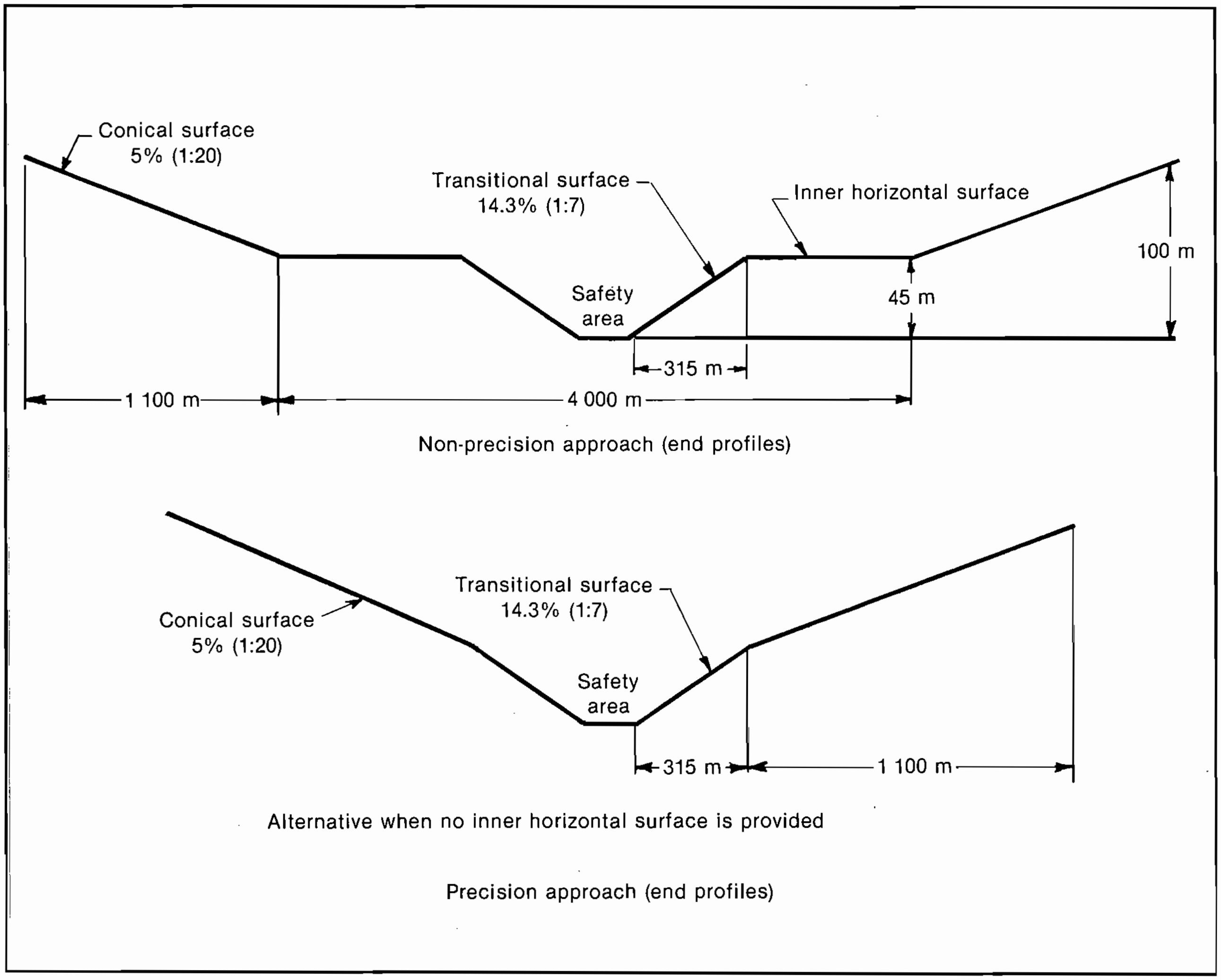


Figure 3-13. Transitional, inner horizontal and conical obstacle limitation surfaces

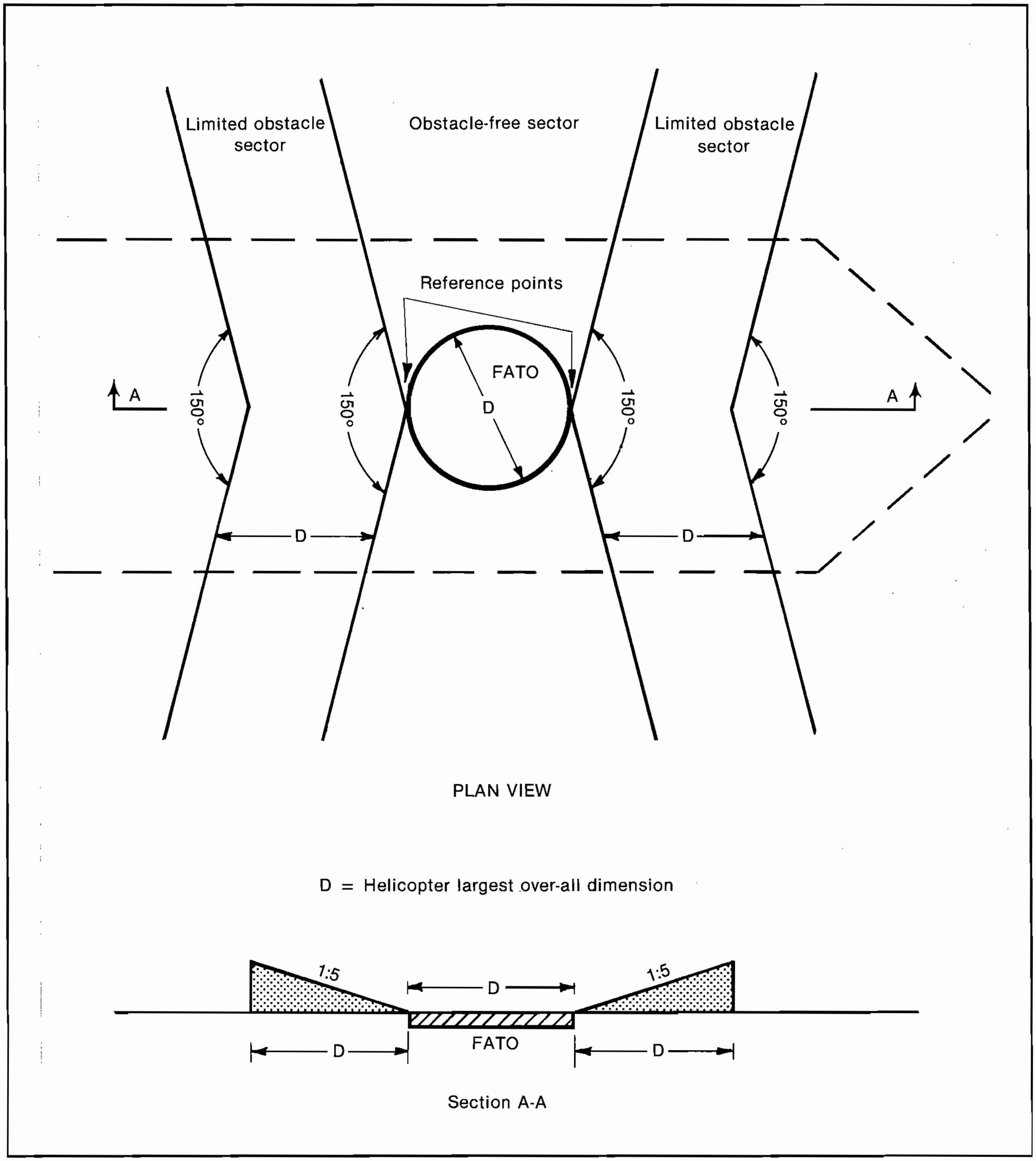


Figure 3-14. Midship non-purpose built heliport obstacle limitation surfaces

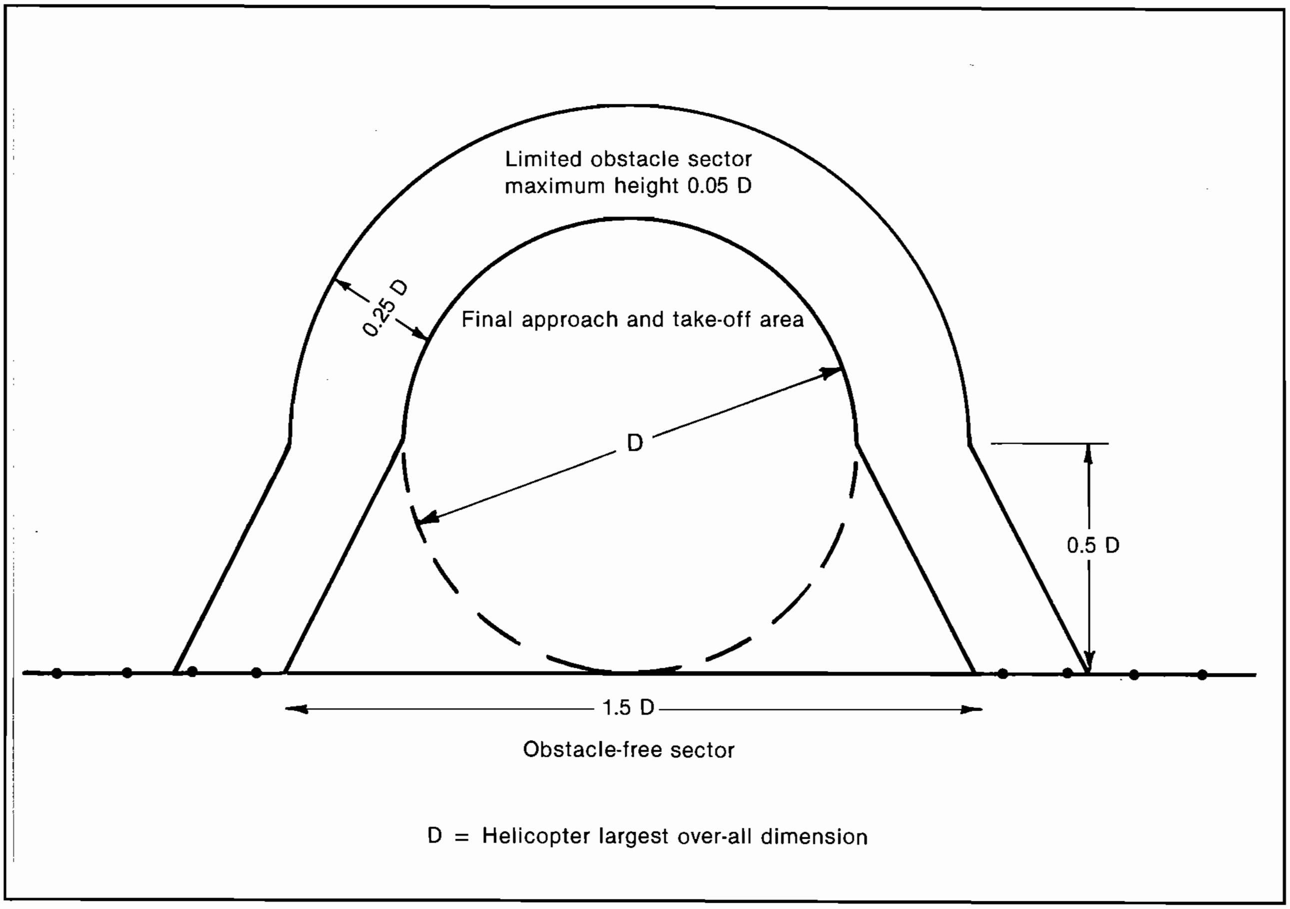


Figure 3-15. Ships-side non-purpose built heliport obstacle limitation surfaces

Table 3-1. Dimensions and slopes of obstacle limitation surfaces

NON-INSTRUMENT AND NON-PRECISION FATO

Surface and dimensions		Non-instrument (visual) FATO — Helicopter performance class 1	2	3	Non-precision (instrument approach) FATO
APPROACH SURFACE					
Width of inner edge			Width of safety area		Width of safety area
Location of inner edge			Boundary		Boundary
First section					
Divergence	— day	10%	10%	10%	16%
	— night	15%	15%	15%	
Length	— day	245 m[a]	245 m[a]	245 m[a]	2 500 m
	— night	245 m[a]	245 m[a]	245 m[a]	
Outer width	— day	49 m[b]	49 m[b]	49 m[b]	890 m
	— night	73.5 m[b]	73.5 m[b]	73.5 m[b]	
Slope (maximum)		8%[a]	8%[a]	8%[a]	3.33%
Second section					
Divergence	— day	10%	10%	10%	—
	— night	15%	15%	15%	
Length	— day	c	c	c	—
	— night	c	c	c	
Outer width	— day	d	d	d	—
	— night	d	d	d	
Slope (maximum)		12.5%	12.5%	12.5%	—
Third section					
Divergence		parallel	parallel	parallel	—
Length	— day	e	e	e	—
	— night	e	e	e	
Outer width	— day	d	d	d	—
	— night	d	d	d	
Slope (maximum)		15%	15%	15%	—
INNER HORIZONTAL					
Height		—	—	—	45 m
Radius		—	—	—	2 000 m
CONICAL					
Slope		—	—	—	5%
Height		—	—	—	55 m
TRANSITIONAL					
Slope		—	—	—	20%
Height		—	—	—	45 m

a. Slope and length enables helicopters to decelerate for landing while avoiding unsafe combinations of height and airspeed.
b. The width of the inner edge shall be added to this dimension.
c. Determined by the distance from the inner edge to the point where the divergence produces a width of 7 rotor diameters for day operations or 10 rotor diameters for night operations.
d. Seven rotor diameters over-all width for day operations or 10 rotor diameters over-all width for night operations.
e. Determined by the distance from inner edge to where the approach surface reaches a height of 150 m above the elevation of the inner edge.

Table 3-2. Dimensions and slopes of obstacle limitation surfaces

INSTRUMENT (PRECISION APPROACH) FATO

	3° approach				*6° approach*			
	Height above FATO				*Height above FATO*			
Surface and dimensions	*90 m (300 ft)*	*60 m (200 ft)*	*45 m (150 ft)*	*30 m (100 ft)*	*90 m (300 ft)*	*60 m (200 ft)*	*45 m (150 ft)*	*30 m (100 ft)*
APPROACH SURFACE								
Length of inner edge	90 m	90 m	90 m	90 m	90 m	90 m	90 m	90 m
Distance from end of FATO	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60m
Divergence each side to height above FATO	25%	25%	25%	25%	25%	25%	25%	25%
Distance to height above FATO	1 745 m	1 163 m	872 m	581 m	870 m	580 m	435 m	290 m
Width at height above FATO	962 m	671 m	526 m	380 m	521 m	380 m	307.5 m	235 m
Divergence to parallel section	15%	15%	15%	15%	15%	15%	15%	15%
Distance to parallel section	2 793 m	3 763 m	4 246 m	4 733 m	4 250 m	4 733 m	4 975 m	5 217 m
Width of parallel section	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m
Distance to outer edge	5 462 m	5 074 m	4 882 m	4 686 m	3 380 m	3 187 m	3 090 m	2 993 m
Width at outer edge	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m
Slope of first section	2.5% (1:40)	2.5% (1:40)	2.5% (1:40)	2.5% (1:40)	5% (1:20)	5% (1:20)	5% (1:20)	5% (1:20)
Length of first section	3 000 m	3 000 m	3 000 m	3 000 m	1 500 m	1 500 m	1 500 m	1 500 m
Slope of second section	3% (1:33.3)	3% (1:33.3)	3% (1:33.3)	3% (1:33.3)	6% (1:16.66)	6% (1:16.66)	6% (1:16.66)	6% (1:16.66)
Length of second section	2 500 m	2 500 m	2 500 m	2 500 m	1 250 m	1 250 m	1 250 m	1 250 m
Total length of surface	10 000 m	10 000 m	10 000 m	10 000 m	8 500 m	8 500 m	8 500 m	8 500 m
CONICAL								
Slope	5%	5%	5%	5%	5%	5%	5%	5%
Height	55 m	55 m	55 m	55 m	55 m	55 m	55 m	55 m
TRANSITIONAL								
Slope	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m

Table 3-3. Dimensions and slopes of obstacle limitation surfaces

STRAIGHT TAKE-OFF

Surface and dimensions		Non-instrument (visual) Helicopter performance class 1	2	3	Instrument
TAKE-OFF CLIMB					
Width of inner edge			Width of safety area		90 m
Location of inner edge			Boundary or end of clearway		Boundary or end of clearway
First section					
Divergence	— day	10%	10%	10%	30%
	— night	15%	15%	15%	
Length	— day	a	245 m[b]	245 m[b]	2 850 m
	— night	a	245 m[b]	245 m[b]	
Outer width	— day	c	49 m[d]	49 m[d]	1 800 m
	— night	c	73.5 m[d]	73.5 m[d]	
Slope (maximum)		4.5%*	8%[b]	8%[b]	3.5%
Second section					
Divergence	— day	parallel	10%	10%	parallel
	— night	parallel	15%	15%	
Length	— day	e	a	a	1 510 m
	— night	e	a	a	
Outer width	— day	c	c	c	1 800 m
	— night	c	c	c	
Slope (maximum)		4.5%*	15%	15%	3.5%*
Third section					
Divergence		—	parallel	parallel	parallel
Length	— day	—	e	e	7 640 m
	— night	—	e	e	
Outer width	— day	—	c	c	1 800 m
	— night	—	c	c	
Slope (maximum)		—	15%	15%	2%

a. Determined by the distance from the inner edge to the point where the divergence produces a width of 7 rotor diameters for day operations or 10 rotor diameters for night operations.
b. Slope and length provides helicopters with an area to accelerate and climb while avoiding unsafe combinations of height and airspeed.
c. Seven rotor diameters over-all width for day operations or 10 rotor diameters over-all width for night operations.
d. The width of the inner edge shall be added to this dimension.
e. Determined by the distance from the inner edge to where the surface reaches a height of 150 m above the elevation of the inner edge.

* This slope exceeds the maximum mass one-engine-inoperative climb gradient of many helicopters which are currently operating.

Table 3-4. Criteria for curved take-off climb/approach area

NON-INSTRUMENT FINAL APPROACH AND TAKE-OFF

Facility	*Requirement*
Directional change	As required (120° max).
Radius of turn on centre line	Not less than 270 m.
Distance to inner gate*	(a) For performance class 1 helicopters — not less than 305 m from the end of the safety area or helicopter clearway. (b) For performance class 2 and 3 helicopters — not less than 370 m from the end of the FATO.
Width of inner gate — day	Width of the inner edge plus 20% of distance to inner gate.
— night	Width of the inner edge plus 30% of distance to inner gate.
Width of outer gate — day	Width of inner edge plus 20% of distance to inner gate out to minimum width of 7 rotor diameters.
— night	Width of inner edge plus 30% of distance to inner gate out to a minimum width of 10 rotor diameters.
Elevation of inner and outer gates	Determined by the distance from the inner edge and the designated gradient(s).
Slopes	As given in Tables 3-1 and 3-3.
Divergence	As given in Tables 3-1 and 3-3.
Total length of area	As given in Tables 3-1 and 3-3.

* This is the minimum distance required prior to initiating a turn after take-off or completing a turn in the final phase.

Note.— More than one turn may be necessary in the total length of the take-off climb/approach area. The same criteria will apply for each subsequent turn except that the widths of the inner and outer gates will normally be the maximum width of the area.

Chapter 4

WINCHING AREAS AND UNDERSLUNG LOAD OPERATING AREAS ON SHIPS

4.1 WINCHING AREAS

4.1.1 Certain types of ships are unable to provide the space or obstacle limitation surfaces required to provide either a helideck or a heliport whilst still requiring helicopter support. Therefore they must resort to the provision of an area for winching operations only. Due to the ship's motion, it becomes a difficult handling manoeuvre for the pilot to maintain station whilst winching up or down. For this reason, the winching area is frequently provided over accommodation or similar modules.

4.1.2 The winching area should contain a clear zone which shall be completely free of obstacles. It shall comprise a circle whose diameter is not less than 5.0 m.

4.1.3 Surrounding the clear zone shall be a circular manoeuvring area whose over-all diameter shall be not less than 30 m. Within this area, and outside the clear zone, obstacles may be permitted up to a maximum height of 3.0 m above the clear zone.

4.1.4 The helicopter will normally hover approximately 3.0 m above the highest obstacle in the manoeuvring area (see Figure 4-1).

4.1.5 The following safety precautions should be applied:

a) personnel should be kept well clear of any space immediately beneath the operating area;

b) safe means of access to the winching area should be provided from at least two opposite sides;

c) all doors, portholes, skylights, etc., must be closed in the operating area, in its immediate vicinity and, where appropriate, on all decks below; and

d) all fire and rescue parties should be deployed well clear and sheltered from the operating area, yet within range for immediate fire fighting or rescue duties.

Note.— Because of the hazardous nature of winching operations and the difficult handling control for the pilot during the prolonged hovering manoeuvre necessary, safety will be enhanced if provisions are made for helicopter landing operations in preference to winching, wherever this is practicable.

4.2 UNDERSLUNG LOAD OPERATING AREAS

4.2.1 General considerations

4.2.1.1 When an item of cargo cannot reasonably be stowed in the helicopter cabin area, it must be slung under the helicopter, usually in a suitable cargo net, and suspended from the sling apparatus, provided that the maximum permitted all-up-weight for the helicopter is not exceeded. Similarly, the floor of the cabin may not be stressed sufficiently to accept the weight of a particular load.

4.2.1.2 The helicopter must be capable of hovering out of ground effect with the load attached.

4.2.1.3 When the helicopter moves into forward flight, the load may tend to swing fore and aft and in a turn the swing may also be sideways. The degree of swing will depend largely on the forward speed and radius of turn. The swings may be aggravated by the shape of the slung load and the combination of speed, turn and shape may well result in the load developing into a spin.

4.2.1.4 Severe swinging of the load can cause the centre of gravity of the helicopter to shift beyond permitted limits. In these circumstances, it may be very difficult to damp out the swings before control of the helicopter is lost.

4.2.1.5 When a ship is to be the arrival destination of an underslung load, the selected set-down area must be sufficiently strong to support the load. It must be large enough to accommodate the load and the handling crew necessary to attend it. It must also provide a sufficiently large, obstacle-free area over which the helicopter can make its final approach and manoeuvre in the hover, bearing in mind the handling problems discussed in 4.2.1.3 and 4.2.1.4.

4.2.1.6 The handling crew must be adequately trained to handle, engage and disengage the load and to give accurate marshalling directions to the helicopter crew.

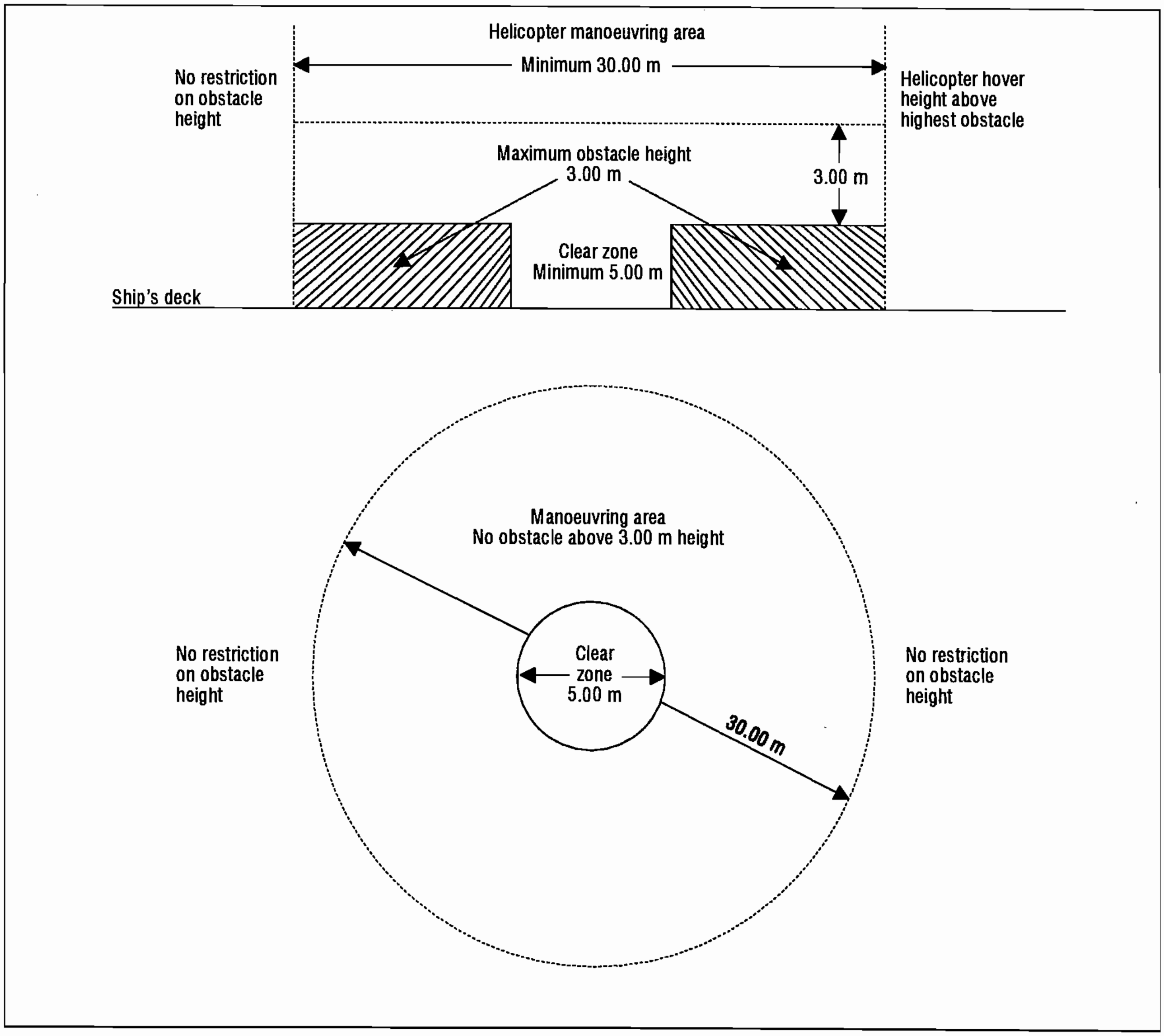


Figure 4-1. Winching area

4.2.2 Underslung load area selection

4.2.2.1 In view of the considerations given in 4.2.1.1 to 4.2.1.6, it is considered that a winching area on a ship would not adequately meet all the requirements for underslung load operations, that is, it may not be large enough, the surface of the winching area may not be sufficiently load bearing, it is unlikely to provide the desired obstacle-free areas and those of the ship's crew who are normally used to assist winching operations are unlikely to be adequate in numbers or training to handle the underslung load operations.

4.2.2.2 It is concluded, therefore, that underslung load operations on ships can only be safely carried out if the areas selected are the ship's heliport or helideck, as applicable.

4.2.3 Operating conditions

4.2.3.1 The ship should be stationary throughout the underslung load operation.

4.2.3.2 The ship should head as nearly into wind as possible except when operations are to amidships or ship's side heliports when the wind should be 90° from the ship's heading, from whichever side affords the helicopter the best headwind component.

4.2.3.3 For underslung load operations to amidships or ship's side heliports, the ship's rail must be removed or lowered adjacent to the heliport for a distance of at least the width of the obstacle-free and limited obstacle sectors where they meet the ship's rail.

Chapter 5

VISUAL AIDS

5.1 GENERAL

A heliport meant for use by day and then only in good visibility conditions will need to display markings only. On the other hand, if the heliport is intended for use by night or in restricted visibility conditions by day or night it will need to be lighted as well. The marking and lighting aids described in this chapter are those included in Annex 14, Volume II, and have been developed primarily to support non-precision approaches and operations in visual meteorological conditions.

5.2 SURFACE LEVEL HELIPORTS

5.2.1 Indicators

5.2.1.1 *Wind direction indicator.* The purpose of the wind direction indicator is to provide the wind direction and give an indication of wind speed. Each heliport should be provided with at least one wind direction indicator.

5.2.1.2 An indicator should be a truncated cone as shown in Figure 5-1. The cone should be of either a single colour (white or orange) or a combination of two colours (orange and white, red and white or black and white). The indicator should be sited to avoid the effects of turbulence and should be of sufficient size to be visible from helicopters flying at a height of 200 m. Where a touchdown and lift-off area may be subjected to a disturbed air flow then additional small lightweight wind vanes located close to the area may prove useful.

5.2.2 Marking aids

5.2.2.1 The following markings/marker will prove useful under the conditions specified for each aid at a surface level heliport intended for operation by day:

a) heliport identification marking;

b) final approach and take-off area marking or marker;

c) final approach and take-off area designation marking;

d) touchdown and lift-off area marking;

e) aiming point marking;

f) touchdown marking;

g) taxiway marking;

h) air taxiway markers;

i) air transit route markers;

j) heliport name marking; and

k) obstacle marking.

5.2.2.2 *Heliport identification marking.* As the name implies, the purpose of the heliport identification marking is to identify a heliport as such. This marking is therefore provided at all surface level heliports and generally consists of a letter "H", white in colour. An exception to this general rule is a heliport located at a hospital where the marking consists of a letter "H", red in colour on a white cross (see Figure 5-2). Such a change is considered necessary to readily identify a heliport located at a hospital. The marking is located at or near the centre of the final approach and take-off area, or at each end of the area when used in conjunction with designation markings as shown in Figure 5-4. The marking is always oriented with the cross arm of the "H" at right angles to the preferred approach direction. For the dimensions of the marking, reference should be made to Figure 5-2.

5.2.2.3 *Final approach and take-off area marking/marker.* This aid defines the boundary of the final approach and

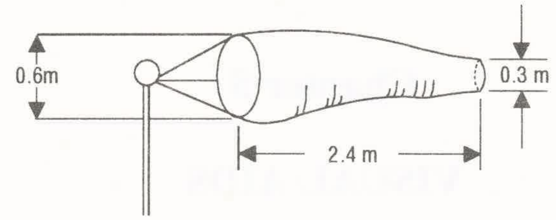


Figure 5-1. Wind direction indicator for a surface level heliport

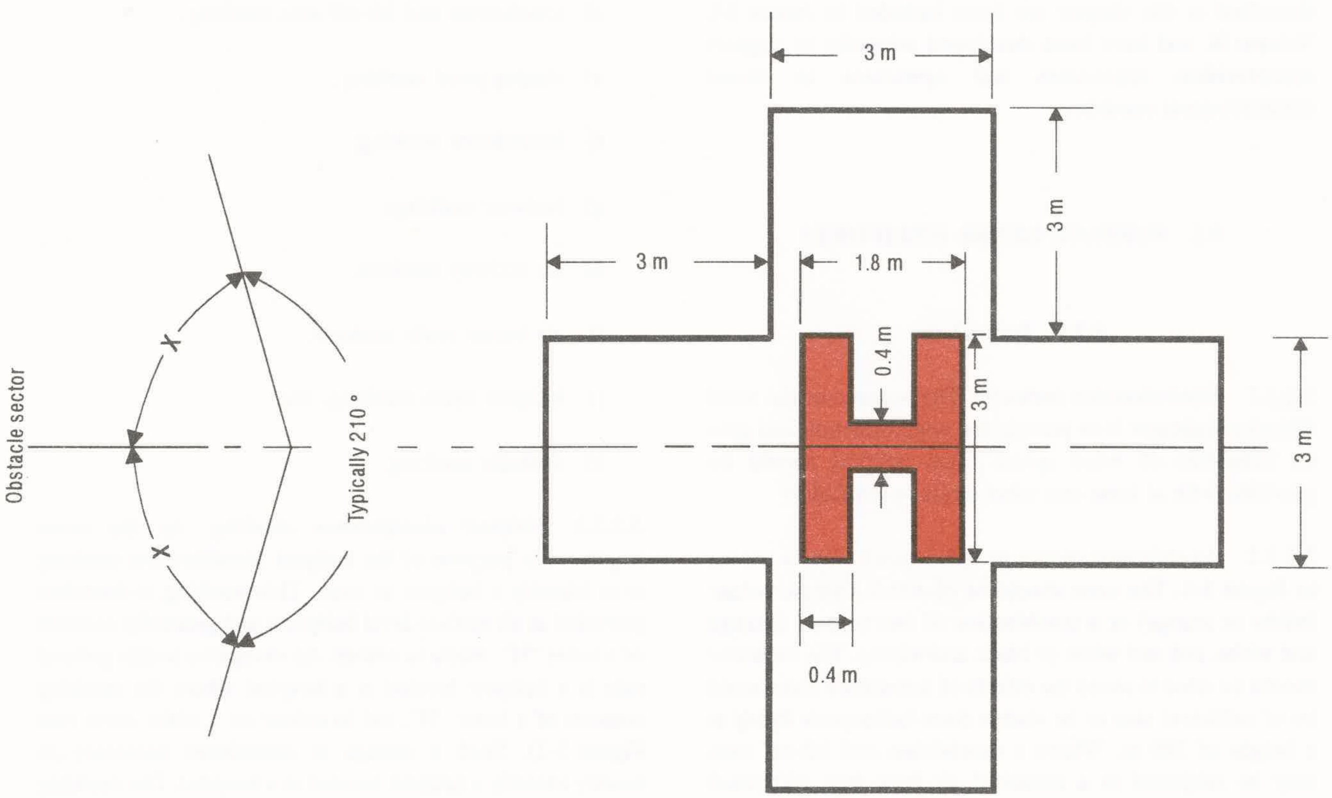


Figure 5-2. Heliport identification marking
(Shown with hospital cross and orientation with obstacle sector)

take-off area and is necessary only where the extent of the area is not self-evident. Either markings or markers can be used for this purpose (see Figure 5-3). In either case, the characteristics included in Annex 14, Volume II, should be met. The spacing of the marking/marker should never exceed 50 m for a rectangular area. Additionally, for a square or rectangular area there should at least be three markings/markers on each side (including a marking/marker at each corner). For a circular area there should be at least five markings/markers with a maximum spacing of 10 m.

5.2.2.4 *Final approach and take-off area designation marking.* This marking aid identifies a particular final approach and take-off area and will need to be displayed only where it is necessary to distinguish one final approach and take-off area from another. The marking shall consist of a runway designation marking specified in Annex 14, Volume I, Chapter 5, supplemented by a letter "H" as in Figure 5-4.

5.2.2.5 *Touchdown and lift-off area marking.* This marking outlines the limits of the touchdown and lift-off area and will need to be displayed at a surface level heliport only where the perimeter of the touchdown and lift-off area is not self-evident. The marking shall consist of a continuous white line at least 30 cm in width, as shown in Figure 5-3.

5.2.2.6 *Aiming point marking.* An aiming point marking will need to be displayed only where it is desired that a pilot make an approach to a particular point on the final approach and take-off area. The marking shall be an equilateral triangle and its dimensions shall be as shown in Figure 5-5. The sides of the triangle shall be composed of continuous white lines 1 m in width.

5.2.2.7 *Touchdown marking.* This marking should be provided where it is necessary or desirable for a helicopter to touch down or park in a specific position, for example, to clear an obstacle. The marking shall be a yellow circle with an inner diameter equal to half the D value of the largest helicopter for which the marking is intended or 6 m whichever is the greater. The line width shall be at least 0.5 m.

5.2.2.8 *Taxiway marking.* Taxiways meant for ground taxiing of helicopters should be marked in the same manner as a taxiway for aeroplanes (see Annex 14, Volume I, Chapter 5).

5.2.2.9 *Air taxiway markers.* Where air taxiways are established their centre lines should be marked with markers as shown in Figure 5-6. These markers shall be frangible and located along the centre line of the air taxiway and shall be spaced at intervals of not more than 30 m on straight sections and 15 m on curves. The surface of the marker as viewed by a pilot shall be a rectangle with a height to width ratio not greater than 3 to 1, and have a minimum area of 150 cm^2. The marker shall show three horizontal bands coloured yellow, green and yellow respectively and shall not exceed 35 cm above ground or snow level.

5.2.2.10 *Air transit route marker.* Where air transit routes are established their centre lines should be marked with markers as shown in Figure 5-7. The markers shall be frangible and located along the centre line of the air transit route. The markers shall be spaced at intervals of not more than 60 m on straight sections and 15 m on curves. The surface of the marker as viewed by a pilot shall be a rectangle with a height to width ratio of approximately 1 to 3 and have a minimum area of 1 500 cm^2. The marker shall show three vertical bands coloured yellow, green and yellow respectively and shall not exceed 1 m above ground or snow level.

5.2.2.11 *Heliport name marking.* A heliport name marking shall be provided and this marking should consist of the name or the alphanumeric designator of the heliport as used in the R/T communications. The characters of the marking should be not less than 3 m in height. At a heliport where an obstacle sector exists the heliport name marking should be located on the obstacle side of the "H" identification marking as shown in Figure 5-11.

5.2.2.12 *Obstacle marking.* All obstacles should be marked following the specifications in Annex 14, Volume I, Chapter 6.

5.2.3 Lighting aids

5.2.3.1 The following lighting aids will prove useful under the conditions specified for each aid at a surface level heliport intended for operations at night or in restricted visibility conditions by day or night:

a) heliport beacon;

b) approach lighting system;

c) alignment guidance system;

d) approach slope indicator;

e) final approach and take-off area lights;

f) aiming point lighting;

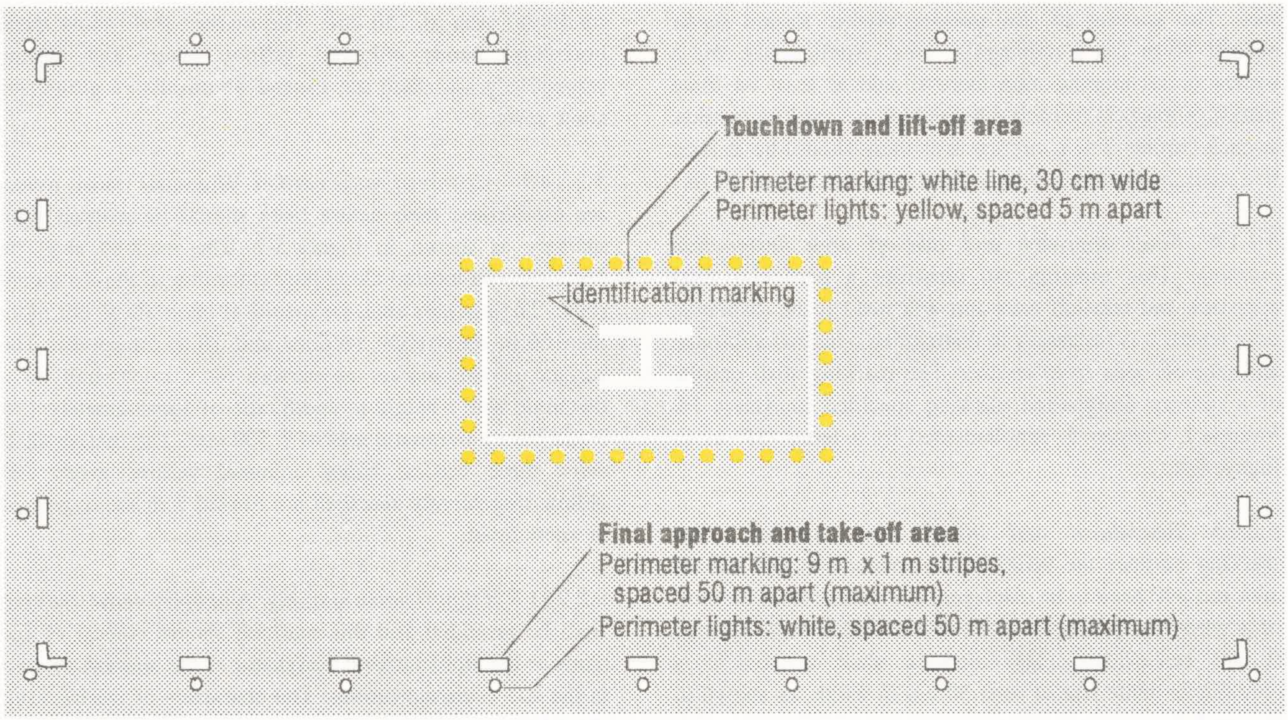


Figure 5-3. Marking and lighting of a typical surface level heliport

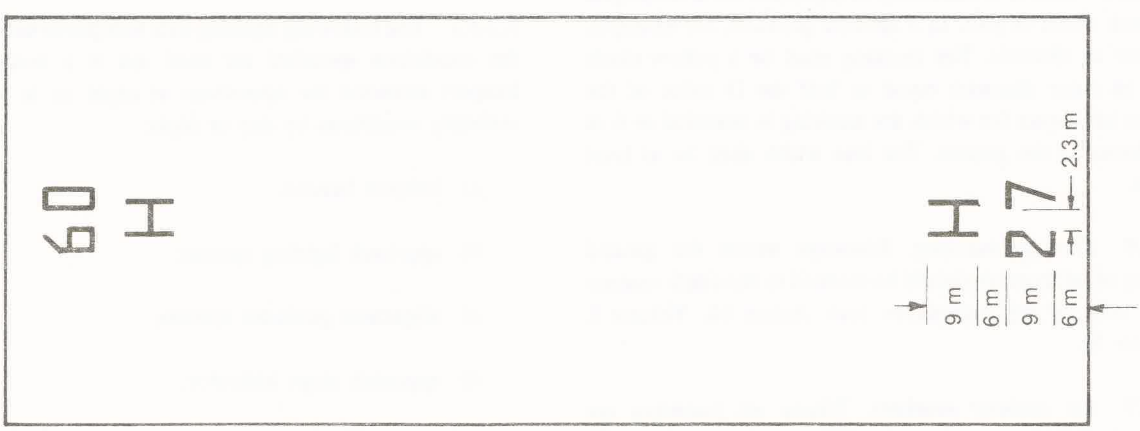


Figure 5-4. Final approach and take-off area designation marking

g) touchdown and lift-off area lighting;

h) taxiway lighting;

i) air taxiway lighting;

j) air transit route lighting; and

k) obstacle lighting.

Figure 5-8 shows the isocandela diagrams of lights meant for helicopter non-instrument and non-precision approaches.

5.2.3.2 *Heliport beacon.* Where long-range visual guidance is considered necessary and is not provided by other visual means or where identification of the heliport is difficult due to surrounding lights, the provision of a heliport beacon is recommended. The heliport beacon shall emit repeated series of equispaced short duration white flashes in the format shown in Figure 5-9. To ensure that pilots are not dazzled during the final stages of the approach and landing, brilliancy control (with 10 per cent and 3 per cent settings) or shielding should be provided. The effective light intensity distribution of each flash should be as shown in Figure 5-8, Illustration 1.

5.2.3.3 *Approach lighting system.* An approach lighting system should be provided at a heliport where it is desirable and practicable to indicate a preferred approach direction, to enhance closure rate information to pilots at night or to provide approach guidance for non-precision approaches.

5.2.3.4 The approach lighting system shall be located in a straight line along the preferred direction of approach. The system basically consists of a row of three lights spaced uniformly at 30 m intervals with a crossbar 18 m in length at a distance of 90 m from the perimeter of the final approach and take-off area. The number of lights along the row is increased to at least seven extending over a distance of 210 m for non-precision approaches and where the identification of the approach lighting system may be difficult. The lights shall be omnidirectional steady white lights except that beyond the crossbar either omnidirectional steady or flashing white lights may be used. The light distribution of steady and flashing lights should be as indicated in Figure 5-8, Illustrations 2 and 3 respectively. However, for a non-precision final approach and take-off area, the intensity of the lights should be increased by a factor of 3. Three different configurations of the approach lighting system are shown in Figure 5-10.

5.2.3.5 *Visual alignment guidance system.* If such a system is required to be provided, see Section 5.4 for guidance.

5.2.3.6 *Approach slope indicator.* The standard visual approach slope indicator systems for helicopter operations are precision approach path indicator (PAPI), abbreviated precision approach path indicator (APAPI) or helicopter approach path indicator (HAPI). One of these systems should be provided to serve the approach to a heliport, whether or not the heliport is served by other visual approach aids or by non-visual aids, where one or more of the following conditions exist especially at night:

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

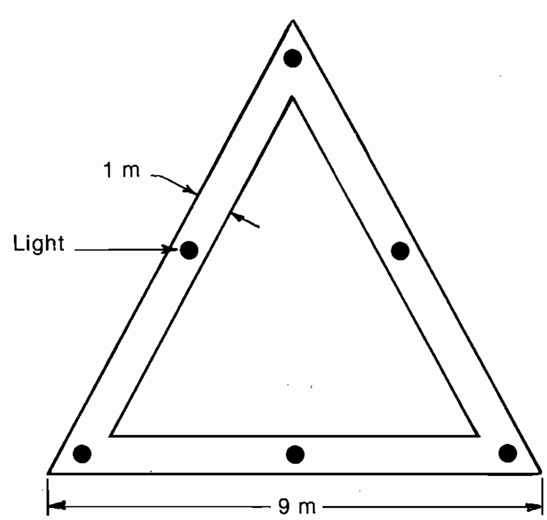


Figure 5-5. Aiming point marking and lighting

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

c) the characteristics of the helicopter require a stabilized approach.

5.2.3.7 The characteristics of the PAPI and APAPI light units should correspond to those specified in Annex 14, Volume I. For further guidance on PAPI and APAPI light units reference should be made to the *Aerodrome Design Manual*, Part 4 — *Visual Aids* (Doc 9157). For guidance on HAPI, reference should be made to Section 5.5.

5.2.3.8 *Final approach and take-off area lights.* These lights are used to delineate the boundaries of the final approach and take-off area (see Figure 5-3). Where the final approach and take-off area and the touchdown and lift-off area are nearly coincidental it is permissible to omit the final approach and take-off area lights. The lights shall be fixed omnidirectional lights showing variable white. The intensity and beam spreads of the lights should conform to those in Figure 5-8, Illustration 5.

5.2.3.9 *Aiming point lighting.* When provided, an aiming point lighting shall consist of omnidirectional white lights. The lights are located as shown in Figure 5-5 and the light distribution should be as shown in Figure 5-8, Illustration 5.

5.2.3.10 *Touchdown and lift-off area lighting system.* This lighting system consists of one or more of the following:

a) perimeter lights; or

b) floodlighting; or

c) luminescent panel lighting when a) and b) are not practicable and final approach and take-off area lights are available.

5.2.3.11 The perimeter lights shall be placed along the edge of the area designated for use as the touchdown and lift-off area or within a distance of 1.5 m from the edge. Where the touchdown and lift-off area is a circle, the perimeter lights shall be located on straight lines in a pattern which will provide information to pilots on drift displacement. Where it is not practicable to so locate the lights, they should be evenly spaced around the perimeter of the area at the appropriate interval except that over a sector of 45° the lights shall be placed at half spacing. Perimeter lights shall be uniformly spaced at intervals of not more than 5 m and there shall be a minimum number of four lights on each side including a light at each corner. For circular areas, there shall be a minimum of fourteen lights. Perimeter lights shall be fixed omnidirectional lights showing yellow. The light distribution of perimeter lights should conform to that specified in Figure 5-8, Illustration 6. The perimeter lights should not exceed a height of 25 cm or should be inset when they could endanger helicopter operations.

5.2.3.12 The floodlights should ensure an average horizontal illuminance of at least 10 lux with a uniformity ratio of eight to one (average to minimum), measured on the surface of the touchdown and lift-off area. The floodlights shall be located so as to avoid glare to pilots at the final stages of approach and landing and the arrangement and aiming of the lights shall be such that shadows are kept to a minimum.

5.2.3.13 Luminescent panel lights shall be placed along the marking designating the edge of the touchdown and lift-off area. Where this area is a circle, the panels shall be located on straight lines circumscribing the area. The minimum number of panels shall be nine and the total length of panels in a pattern shall not be less than 50 per cent of the length of the pattern. There shall be an odd number with a minimum number of three panels on each side of the touchdown and lift-off area including a panel at each corner. The panels shall be equispaced with a distance between adjacent panel ends of not more than 5 m on each side of the touchdown and lift-off area. Luminescent panels shall emit yellow light when they are used to define the boundary of the area and the light distribution should be as shown in Figure 5-8, Illustration 7. The panels shall have a minimum width of 6 cm and shall not extend above the surface by more than 2.5 cm.

5.2.3.14 *Taxiway lighting.* Taxiways meant for ground taxiing of helicopters should be lighted in the same manner as a taxiway meant for use by aeroplanes (see Annex 14, Volume I, Chapter 5).

5.2.3.15 *Air taxiway lighting.* This lighting is used to mark the centre lines of air taxiways for operations at night or in low visibility conditions. Air taxiway lighting consists of air taxiway markers internally illuminated or rendered retro-reflective.

5.2.3.16 *Air transit route lighting.* This lighting is used to mark the centre lines of air transit routes for operations at night or low visibility conditions. Air transit route lighting consists of air transit route markers internally illuminated or rendered retro-reflective.

5.2.3.17 *Obstacle lighting.* An obstacle at a heliport should be lighted in the same manner as at an airport; see the specifications in Annex 14, Volume I, Chapter 6.

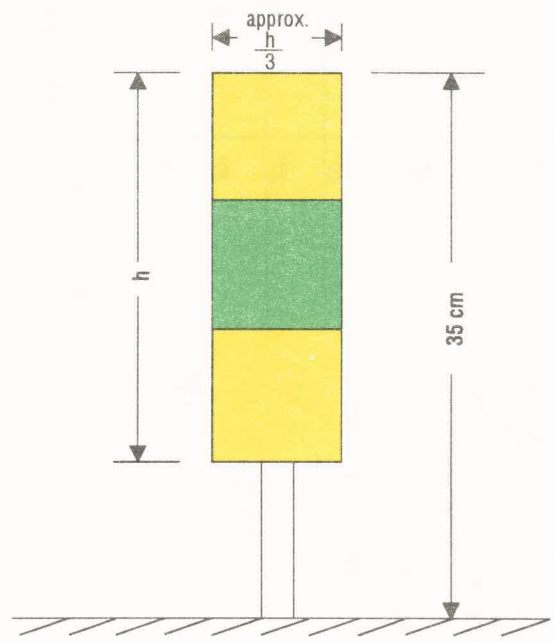


Figure 5-6. Air taxiway marker

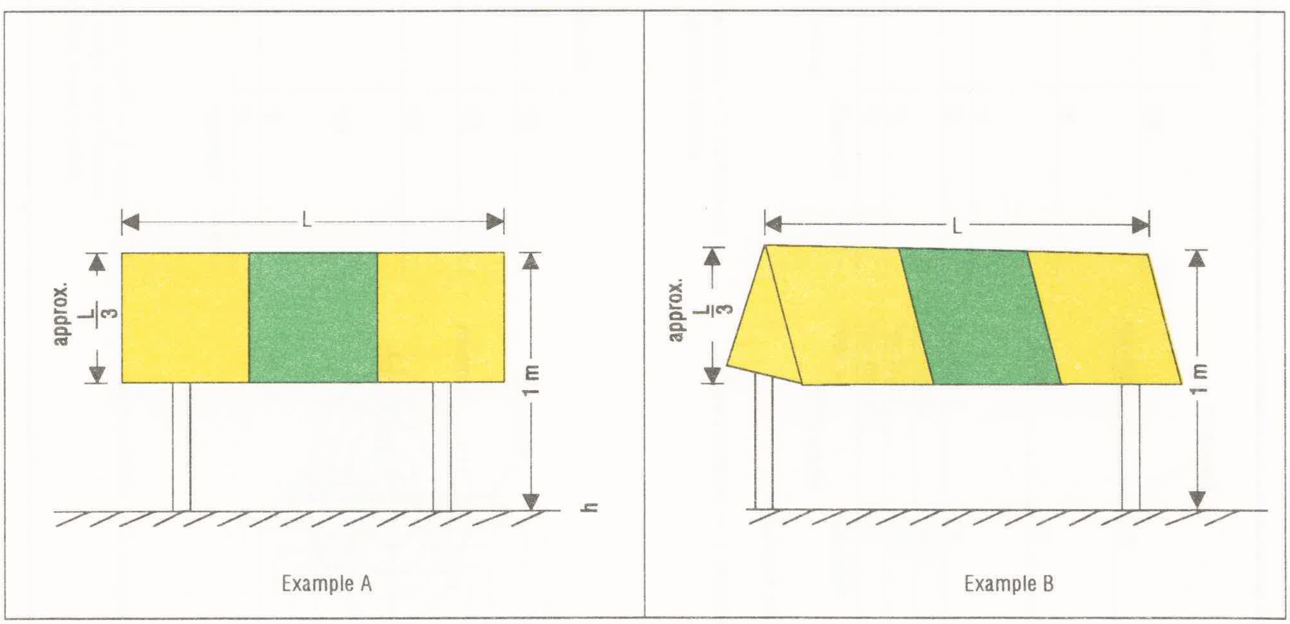
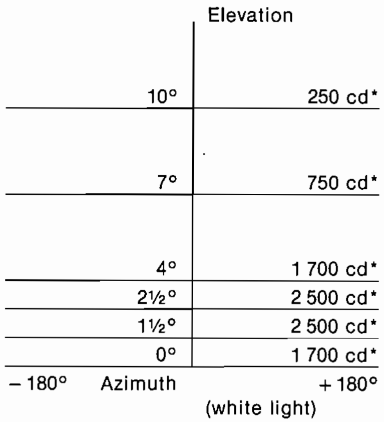


Figure 5-7. Air transit route marker



* Effective intensity

Illustration 1 — Heliport beacon

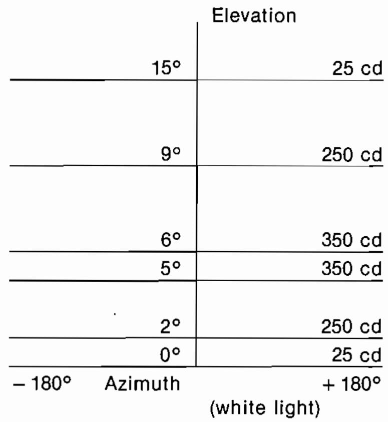
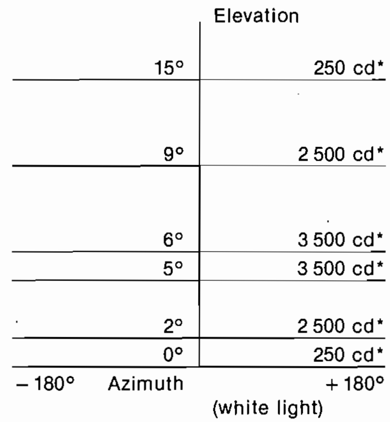


Illustration 2 — Approach light steady burning



* Effective intensity

Illustration 3 — Approach light flashing

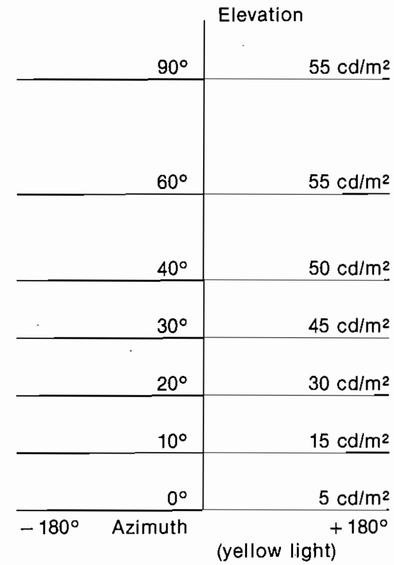


Illustration 7 — Touchdown and lift-off area electro-luminescent panels

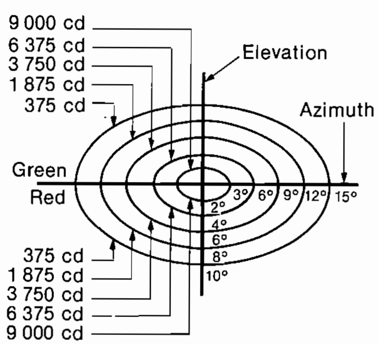


Illustration 4 — HAPI system

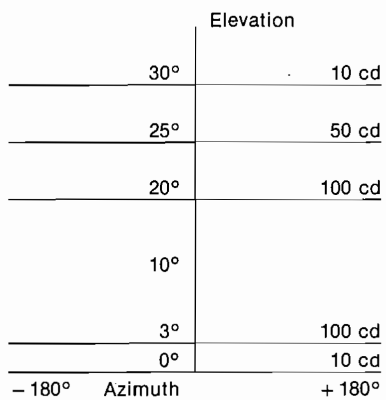


Illustration 5 — Final approach and take-off area lights and aiming point lights

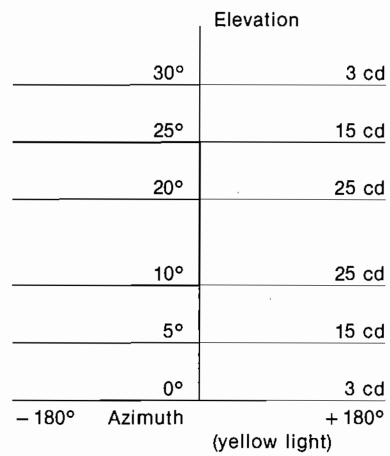


Illustration 6 — Touchdown and lift-off area perimeter lights

Figure 5-8. Isocandela diagrams of lights meant for helicopter non-instrument and non-precision approaches

5.3 ELEVATED HELIPORTS AND HELIDECKS

Note.— The guidance in this section is intended for elevated heliports. In the case of helidecks, consideration has been given only to heliports that receive frequent operations such as oil rigs, factory ships and research ships that have specifically designed and constructed helidecks.

5.3.1 Indicators

Wind direction indicator. Each elevated heliport should be provided with at least one wind direction indicator. The requirements in 5.2.1.1 and 5.2.1.2 concerning the colour and location of wind direction indicators are also applicable to wind direction indicators meant for use at elevated heliports and helidecks. However, the indicators may be half the size of that shown in Figure 5-1 to accommodate space limitations at an elevated heliport or helideck. On helidecks two wind direction indicators may be needed because the air over the touchdown and lift-off area may be subject to disturbed air flow. Undetected turbulence on and above a helideck is a great hazard to helicopters. This turbulence may stem from structures in the vicinity of the helideck (cranes, super structures, power turbine exhaust gas, etc.) which may change the vertical and horizontal direction of free air flow over the helideck, from the level of the deck up to at least 15 m above it. In those circumstances, wind direction indicators shall be of the larger size (i.e. 2.40 m long, as shown in Figure 5-1).

Note.— The 15 m figure mentioned above is due to a landing technique taking into account the loss of one engine during the landing phase when the power demand is usually high. The unsuspected presence of hot gases or any change in the horizontal or vertical wind direction may reduce the available power margin to an unacceptable value.

5.3.2 Marking aids

The following marking aids will prove useful at an elevated heliport or a helideck (see Figure 5-11). In most instances the aids are the same as those for surface level heliports detailed in Section 5.2.

a) *Heliport identification marking* (see 5.2.2.2);

b) *Maximum allowable mass marking.* This marking should be displayed where there is a danger of a helicopter with a mass greater than the design mass of the heliport using the heliport. The marking should consist of a two-digit number followed by a letter "t" to indicate the mass in tonnes, i.e. 1 000 kg (see Figure 5-11). The marking is located so as to be visible from the preferred approach direction. The style and dimensions of the numbers and letters of the marking should correspond to those shown in Figure 5-12;

c) *Final approach and take-off area marking or marker* (see 5.2.2.3). Normally such an area is coincidental with the touchdown and lift-off area and is not marked as such;

d) *Final approach and take-off area designation marking* (see 5.2.2.4);

e) *Touchdown and lift-off area marking* (see 5.2.2.5);

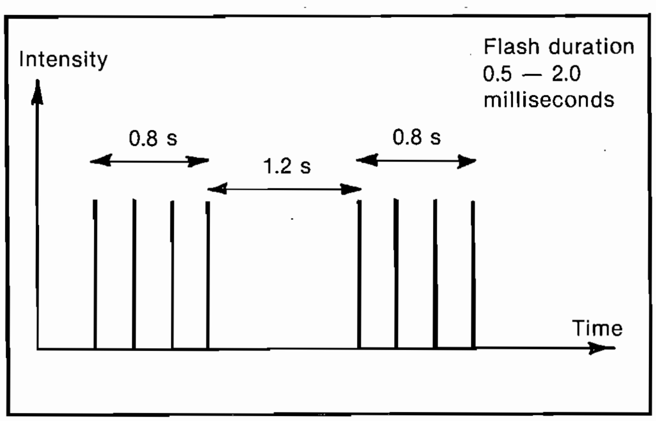


Figure 5-9. Heliport beacon flash characteristics

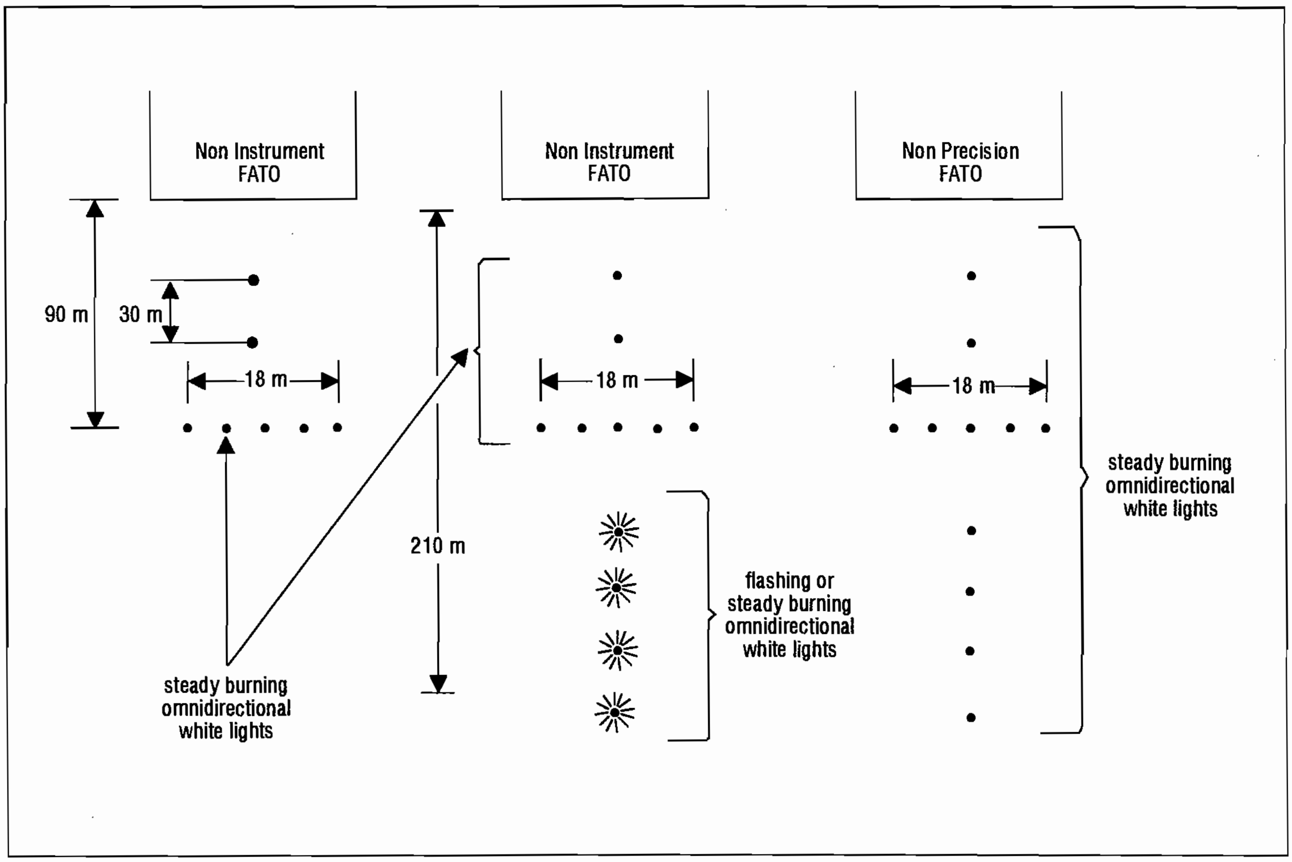


Figure 5-10. Three different configurations of an approach lighting system

f) *Touchdown marking* (see 5.2.2.7). On helidecks, the line width shall be at least 1 m and the inner diameter of the circle shall be half the D value of the helideck or 6 m, whichever is the greater. On elevated heliports and helidecks the centre of the touchdown marking should be located at the centre of the touchdown and lift-off area except that the marking may be offset from the origin of the obstacle-free sector by no more than 0.1 D where an aeronautical study indicates such off-setting to be necessary (see the examples in Figure 5-13);

g) *Heliport name marking* (see 5.2.2.11). The characters of the marking should not be less than 1.2 m in height and should consist of the name or the alphanumeric designator of the heliport as used in the R/T communications. The colour of the marking should provide good contrast with the background. The marking should be readable by pilots approaching the elevated heliport or helideck;

h) *Helideck obstacle-free sector marking.* This marking indicates the origin of the obstacle-free sector, the directions of the limits of the sector (which are indicated by a black chevron 30 cm in height) and the "D" value of the helideck as shown in Figure 5-14. "D" is the largest dimension of the helicopter when the rotors are turning. The colour of the D value marking should provide good contrast with the background; and

i) *Obstacle marking* (see 5.2.2.12).

5.3.3 Lighting aids

5.3.3.1 The following lighting aids will prove useful at an elevated heliport or at a helideck. As for markings, many of the lighting aids detailed in Section 5.2 for surface level heliports are suitable for elevated heliports and helidecks:

a) heliport beacon;

b) visual alignment guidance system;

c) approach slope indicator;

d) final approach and take-off area lights;

e) touchdown and lift-off area lighting; and

f) obstacle lighting.

5.3.3.2 *Heliport beacon* (see 5.2.3.2).

5.3.3.3 *Visual alignment guidance system.* It is impracticable to install an approach lighting system at an elevated heliport or a helideck on account of space limitations. A specially designed system, known as the visual alignment guidance system, should therefore be installed at an elevated heliport or helideck, if there is the need to provide alignment guidance. For further guidance on such a system, see Section 5.4.

5.3.3.4 *Approach slope indicator system.* Space limitations at an elevated heliport or a helideck preclude the installation of a multi-unit system such as the PAPI or APAPI. A single unit indicator, known as the HAPI, should be installed at an elevated heliport or helideck where there is the need to provide approach slope guidance visually. The characteristics of the HAPI shall correspond to those specified in Annex 14, Volume II. Guidance on HAPI light units is given in Section 5.5.

5.3.3.5 *Final approach and take-off area lights* (see 5.2.3.8). Normally this area is coincidental with the touchdown and lift-off area and is not lighted.

5.3.3.6 *Touchdown and lift-off area lighting system.* This lighting shall consist of perimeter lights and floodlighting or luminescent panel lighting; or perimeter lights and a combination of both floodlighting and luminescent panel lighting.

5.3.3.7 The perimeter lights should be installed as specified in 5.2.3.11 except that the lights should be installed at a spacing of not more than 3 m. On a helideck, the lights should be installed such that they cannot be seen from below the surface of the helideck.

5.3.3.8 Floodlighting and/or luminescent panel lighting should be provided at elevated heliports and helidecks to provide surface texture cues within the touchdown and lift-off area. These cues are essential for helicopter positioning during the final approach and landing.

5.3.3.9 The floodlighting should be adequately shielded to ensure that the source of light is not directly visible to a pilot at any stage of landing. The lighting should be designed to provide an average horizontal illuminance of at least 10 lux with a uniformity ratio of 8 to 1 (average to minimum).

5.3.3.10 For some elevated heliports and helidecks, it may not be possible to achieve the uniformity ratio of 8 to 1 over the entire surface, given the fixture height limitation of 25 cm. Depending upon the distance and angle of projection, the centre portion of the deck may have a darkened appearance. In this circumstance, a combination of floodlighting and luminescent lighting may be necessary to provide surface texture cues. For example, an outer annular segment can be floodlit and the inner segment can be lit with luminescent panel lighting.

5.3.3.11 The degree to which the floodlighting is beneficial to the pilot is dependent upon the reflectance of the deck surface. To optimize the performance of the floodlighting system, the deck surface should have high specular reflectance characteristics.

5.3.3.12 When luminescent panels are used on an elevated heliport or a helideck to enhance the surface texture cues, the panels should not be placed adjacent to the perimeter lights. Suitable locations include around a touchdown marking where it is provided or coincident with the heliport identification marking. In those locations, the panels may emit colours other than yellow.

5.3.3.13 *Obstacle lighting.* Obstacle lighting specified for airports is also applicable to elevated heliports and helidecks. However, where obstacle lights cannot be mounted, it is permissible to floodlight the obstacle. The floodlighting should be so designed that it produces a luminance of at least 10 cd/m^2.

5.4 VISUAL ALIGNMENT GUIDANCE SYSTEM

5.4.1 General

5.4.1.1 The visual alignment guidance system defined in Annex 14, Volume II, Section 5.3.3A, is designed to give visual indications of the correct track. This system is mainly recommended when the environment provides few visual surface cues as for offshore operations or when an approach lighting system cannot be installed (e.g. an elevated heliport).

5.4.1.2 The system provides a minimum of three discrete signal sectors giving "offset to the right", "on track" and "offset to the left" indications.

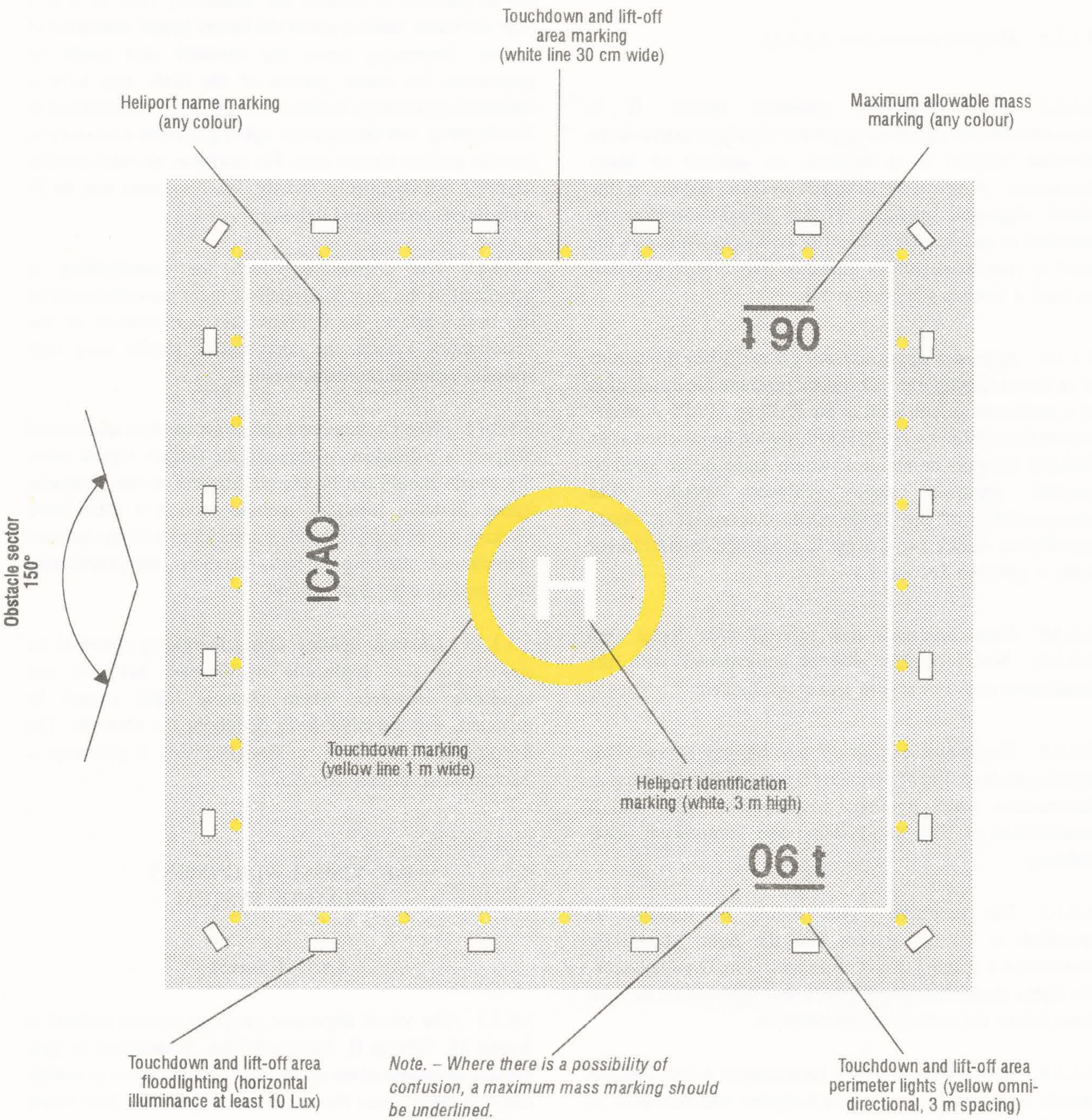
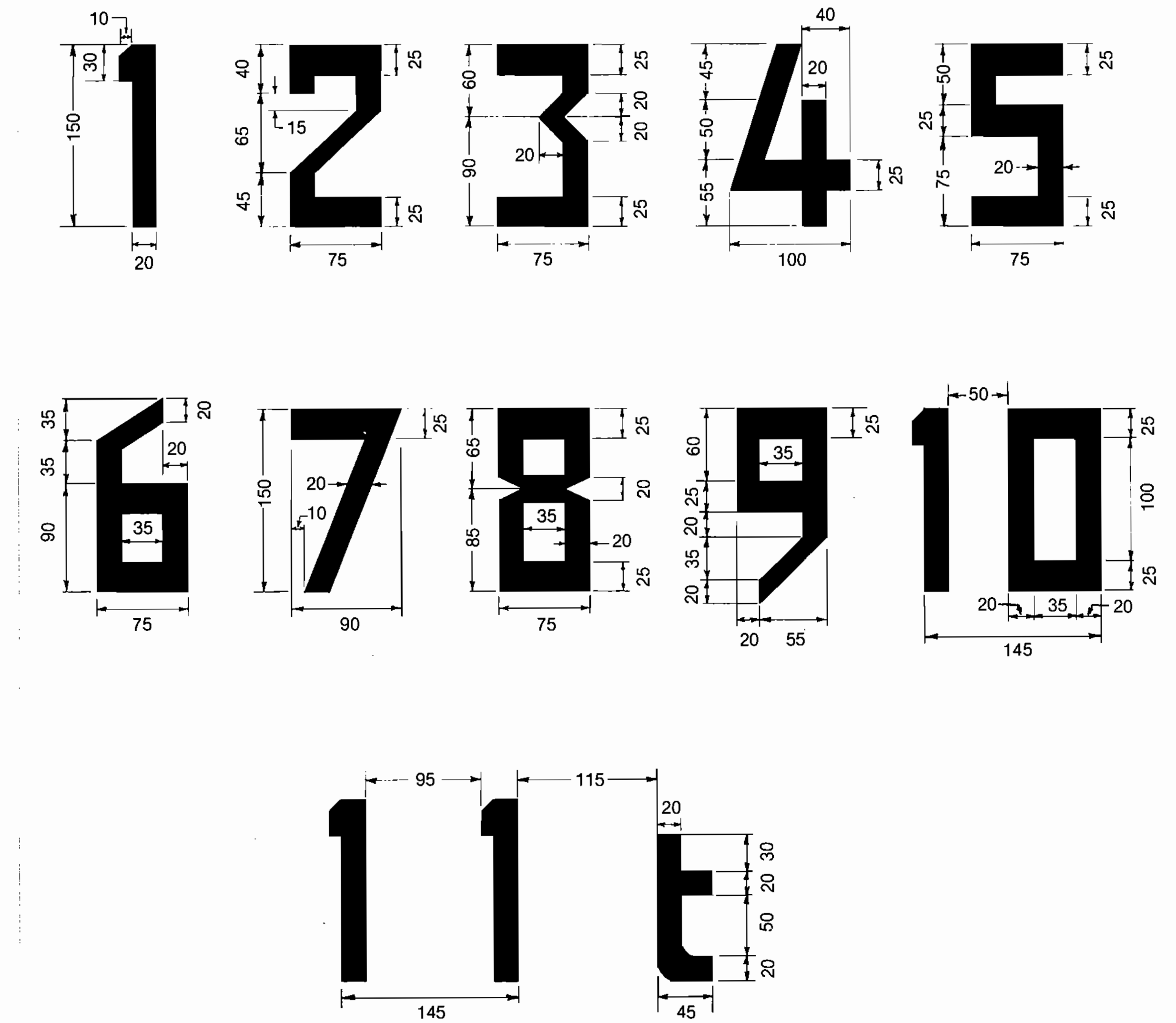


Figure 5-11. Marking and lighting of an elevated heliport



Note.— All units are expressed in centimetres.

Figure 5-12. Form and proportions of numbers and letter for maximum allowable mass marking

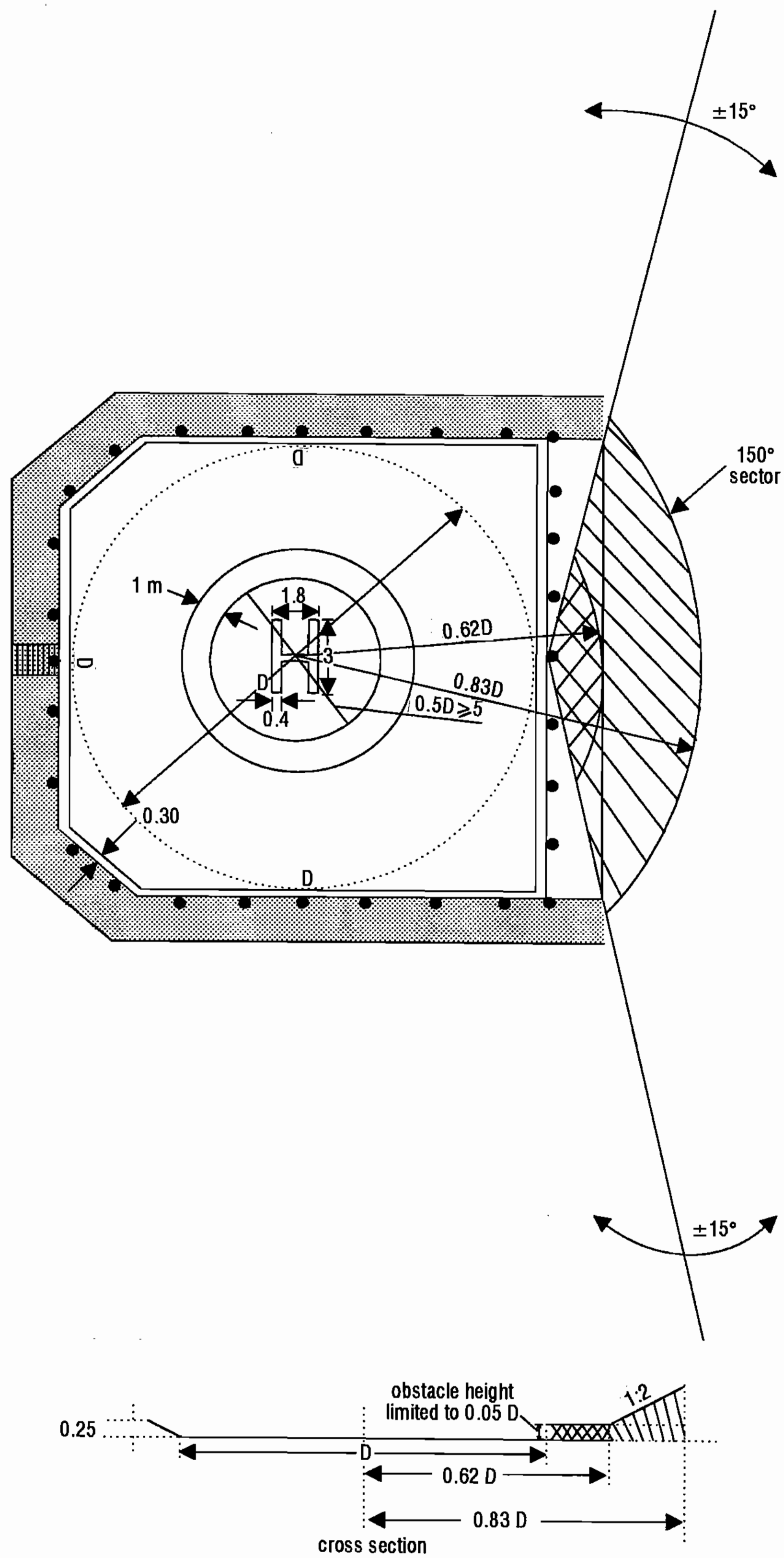


Figure 5-13. Location of touchdown marking
Example A. Centred touchdown marking

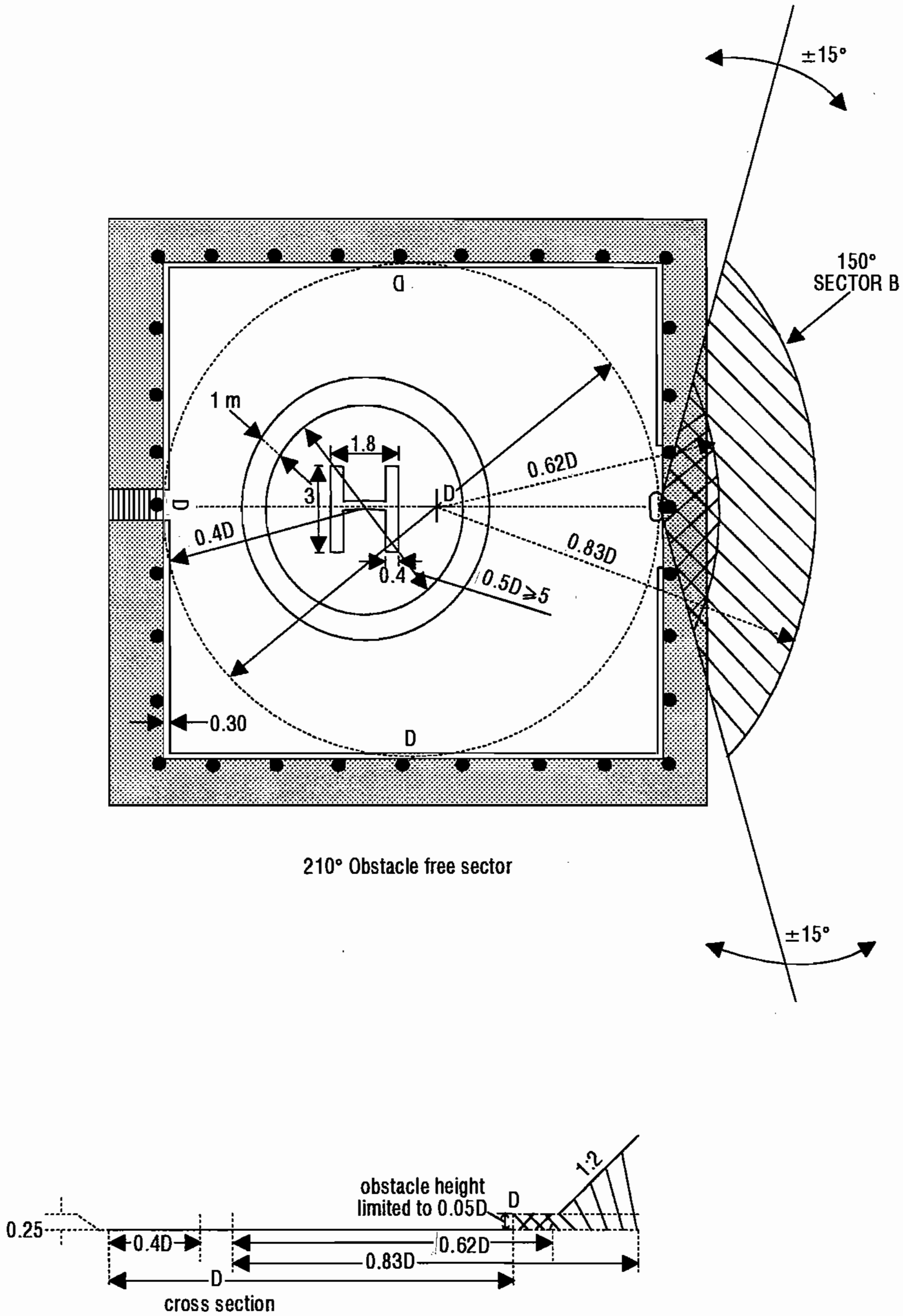


Figure 5-13. Location of touchdown marking
Example B. Offset touchdown marking

Note.— The visual alignment guidance system is closely associated with the safety of helicopter operations. It is considered desirable to remind users of this manual that the system, when installed and used in the prescribed manner, will provide a safe lateral clearance from obstacles when on final approach.

5.4.1.3 The material in this chapter is intended to provide guidance in the application of Annex 14, Volume II, Chapter 5, Section 5.3.3A, considering that:

a) visual alignment guidance systems of different designs will be in use; and

b) visual alignment guidance systems will be installed on heliports or helidecks with widely varying physical characteristics.

5.4.2 Type of signal

5.4.2.1 The signal of the visual alignment guidance system shall be such that there is no possibility of confusion between the system and any associated visual approach slope indicator or other visual aids.

5.4.2.2 The system shall avoid the use of the same coding as any associated visual approach slope indicator (HAPI, PAPI or APAPI).

5.4.2.3 The use of the system shall not significantly increase the pilot workload and the signal format must be unique and conspicuous in all operational environments.

5.4.3 Layout and setting angle

5.4.3.1 The visual alignment guidance system shall be located such that a helicopter is guided along the prescribed track towards the final approach and take-off area and should be placed at its downwind edge and aligned along the preferred approach direction.

5.4.3.2 The system shall be capable of adjustment in azimuth to within ±5 minutes of arc of the desired approach track.

5.4.3.3 Where the lights of the system need to be seen as discrete sources, light units shall be located such that at the extremes of the system coverage the angle subtended

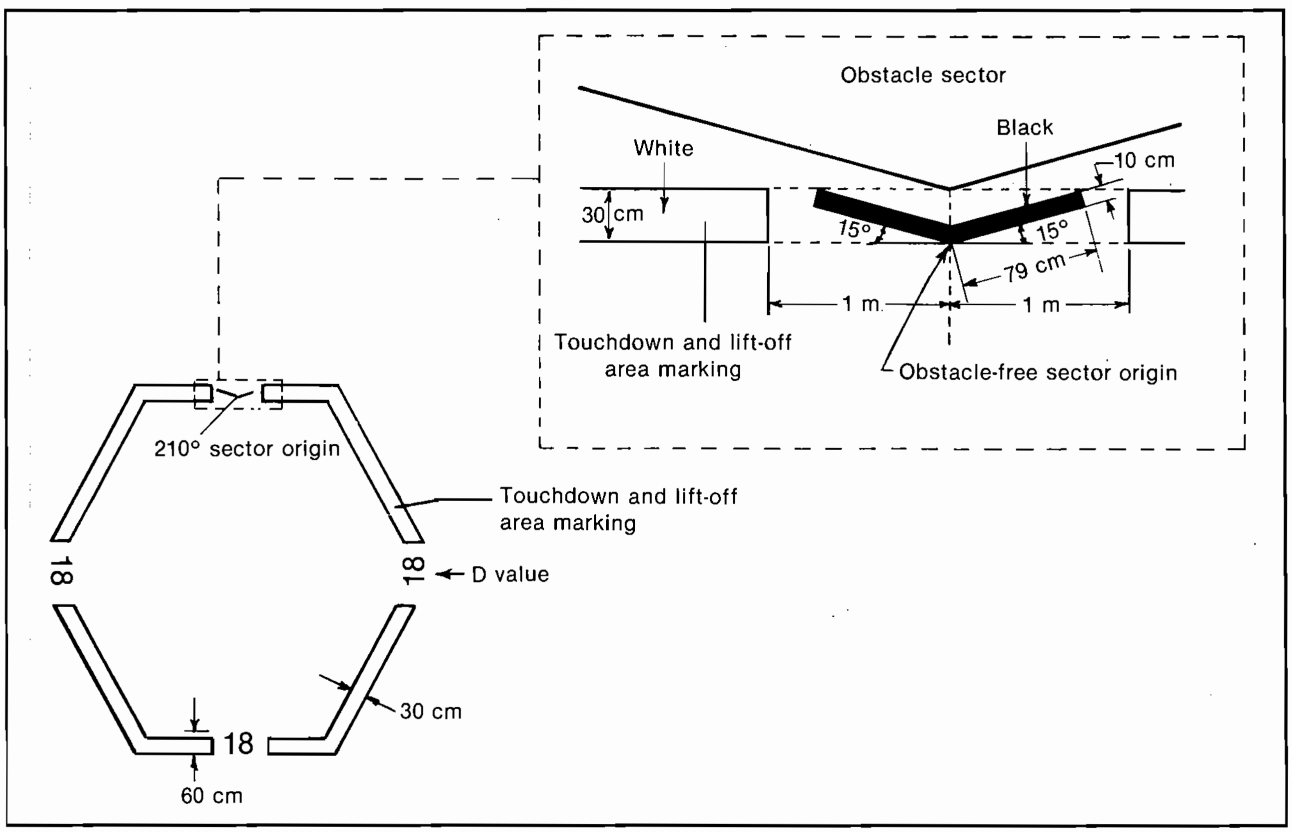


Figure 5-14. Helideck obstacle-free sector marking

between units as seen by the pilot shall not be less than 3 minutes of arc. The angle subtended between light units of the system and other lights of comparable or greater intensity shall also be not less than 3 minutes of arc. This can be met for lights on a line normal to the line of sight if they are separated by 1 m for every kilometre of viewing range.

5.4.3.4 The divergence of the "on track" sector of the system shall be 1°, either side of the centre line.

5.4.4 Brilliancy

A suitable intensity control shall be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing. When the system is used in conjunction with an approach slope indicator, the intensity settings should be compatible.

5.4.5 Characteristics

5.4.5.1 In the event of the failure of any component affecting the signal format the system shall be automatically switched off.

5.4.5.2 The light units shall be so designed that deposits of condensation, ice, dirt, etc., on optically transmitting or reflecting surfaces will interfere to the least possible extent with the light signal and will not cause spurious or false signals to be generated.

5.4.6 Initial flight inspection

A flight inspection of a new installation is recommended to confirm the correct operation of the system. The inspection should include checks of the divergence of the "on track" sector, azimuth and vertical coverage, range, brilliancy control and compatibility with the approach slope indicator.

5.4.7 Routine inspection

5.4.7.1 The initial setting will be accomplished either by the manufacturer's agent or under strict compliance with the manufacturer's installation instructions. Thereafter, a suitable routine inspection schedule should be established to ensure that the system remains operationally safe.

5.4.7.2 A routine check should be made on the visual alignment guidance system to ensure that:

a) all lamps are lighted and illuminated evenly;

b) no evidence of damage is apparent;

c) the signal format is correct;

d) the optically transmitting or reflecting surfaces are not contaminated; and

e) the control systems are operating properly.

5.4.8 Obstacle considerations

The angle of azimuthal setting of the system shall be such that during an approach the pilot of a helicopter at the boundary of the "on track" signal will clear all objects in the approach area by a safe margin. The characteristics of the obstacle protection surface specified in 5.5.15.2, Table 5-1 and Figure 5-19 for visual approach indicators shall equally apply to the system.

5.4.9 Description of a system used in France

5.4.9.1 *Description.* A visual alignment guidance system used in France is illustrated in Figure 5-15. The system consists of six pulsing units arranged in two groups of three units, each as indicated in Figure 5-15. One group is located on the left side of the approach track and the other group on the right side. The system works as follows:

a) when on the correct approach track, the pilot would see the two light units designated as 3R and 3L, simultaneously flashing like a runway threshold identification light specified in Annex 14, Volume I, Section 5.3.9; and

b) when to the left or right of the correct approach track, the pilot would see three lights flashing one after another indicating the direction of correction, for example, 1L→2L→3L if the pilot were to the left of the correct approach track.

5.4.9.2 *Location.* The system should preferably be located on the downwind edge of the final approach and take-off area as shown in Figure 5-15. The separation distances between the light units shall be as shown in that figure. Where a helicopter approach path indicator (HAPI) is used in conjunction with the alignment guidance system, the HAPI should be sited behind the alignment guidance system and at the centre of units 3R and 3L. A spacing of 4 to 5 m between light units 3R and 3L might prove to be adequate where a HAPI is collocated with the system. Where sufficient room is available, the HAPI may be installed aligned with the units of the system and at the centre of units 3R and 3L.

5.4.9.3 *Signal format.* The signal format of the visual alignment guidance system includes three discrete signal sectors providing "offset to the left", "on track" and "offset to the right" signals as shown below.

Sector	*Offset to the left*	*On track*	*Offset to the right*
Signal	Three white lights flashing in sequence from left to right (1L, 2L and 3L)	Two white lights flashing together (3R and 3L)	Three white lights flashing in sequence from right to left (1R, 2R and 3R)

5.4.9.4 The "offset sector" flash characteristics are shown in Figure 5-16.

5.4.9.5 The system also includes two additional narrow sectors providing "slightly offset" signals. In these "slightly offset" sectors, the system shows two white lights flashing in sequence, still indicating the direction of correction.

5.4.9.6 *Setting of the system.* The divergence of the "on track" sector of the system should be set at 1° as shown in Figure 5-15. The system is generally housed in a casing similar to that used for PAPI.

5.4.9.7 *Light distribution.* The system should have the same coverage as envisaged in Annex 14, Volume II, for a visual slope indicator system meant for helicopter operations. This would ensure that a pilot will not lose the signals of either system when they are used in conjunction. The light units have a peak intensity of 15 000 cd.

5.4.9.8 The system provides intensity settings of 100 per cent, 30 per cent and 10 per cent and can be remote-controlled by the pilot from the helicopter.

5.5 HELICOPTER APPROACH PATH INDICATOR

5.5.1 General

5.5.1.1 The helicopter approach path indicator (HAPI) defined in Annex 14, Volume II, Chapter 5, Section 5.3.4, is designed to give visual indications of the desired approach slope and deviations from it.

5.5.1.2 HAPI is a single unit device providing one normal approach path and three discrete deviation indications.

Note.— The helicopter visual approach path indicator system is closely associated with the safety of helicopter operations. It is considered desirable to remind users of this manual that the system, when installed and used in the prescribed manner, will provide a safe margin, clear of all obstacles when on final approach.

5.5.1.3 The material in this chapter is intended to provide guidance in the application of Annex 14, Volume II, Chapter 5, Section 5.3.4, considering that:

a) HAPIs of different designs will be in use; and

b) HAPIs will be installed on heliports or helidecks with widely varying physical characteristics.

5.5.2 Type of signal

5.5.2.1 HAPI is a projector unit producing a light signal, the lower half of which is red and the upper half of which is green. An occulting device creates at the top of the green signal and at the bottom of the red signal, a flashing effect as shown at Figure 5-17.

5.5.2.2 The light distribution of the HAPI in red and green colours should be as shown in Figure 5-8, Illustration 4.

5.5.3 Equipment specifications

5.5.3.1 The transition between the adjacent sectors of the signal should appear to an observer at a distance of not less than 300 m to occur within a vertical angle of not more than 3 minutes.

5.5.3.2 The occulting device shall be so designed that, in case of failure, no light will be emitted in the failed flashing sector.

5.5.4 Setting angles

5.5.4.1 During manufacture, the centre of the plane of transition between the steady-red and -green signals shall be aligned precisely with the unit's horizontal axis (Figure 5-17). The unit setting angle and the centre of the on-course sector are not the same. Thus, the setting angle shall be related to the red-green boundary (see 5.5.13).

5.5.4.2 A HAPI system shall be capable of adjustment in elevation to any desired angle between 1° and 12° above the horizontal with an accuracy of ±5 minutes of arc.

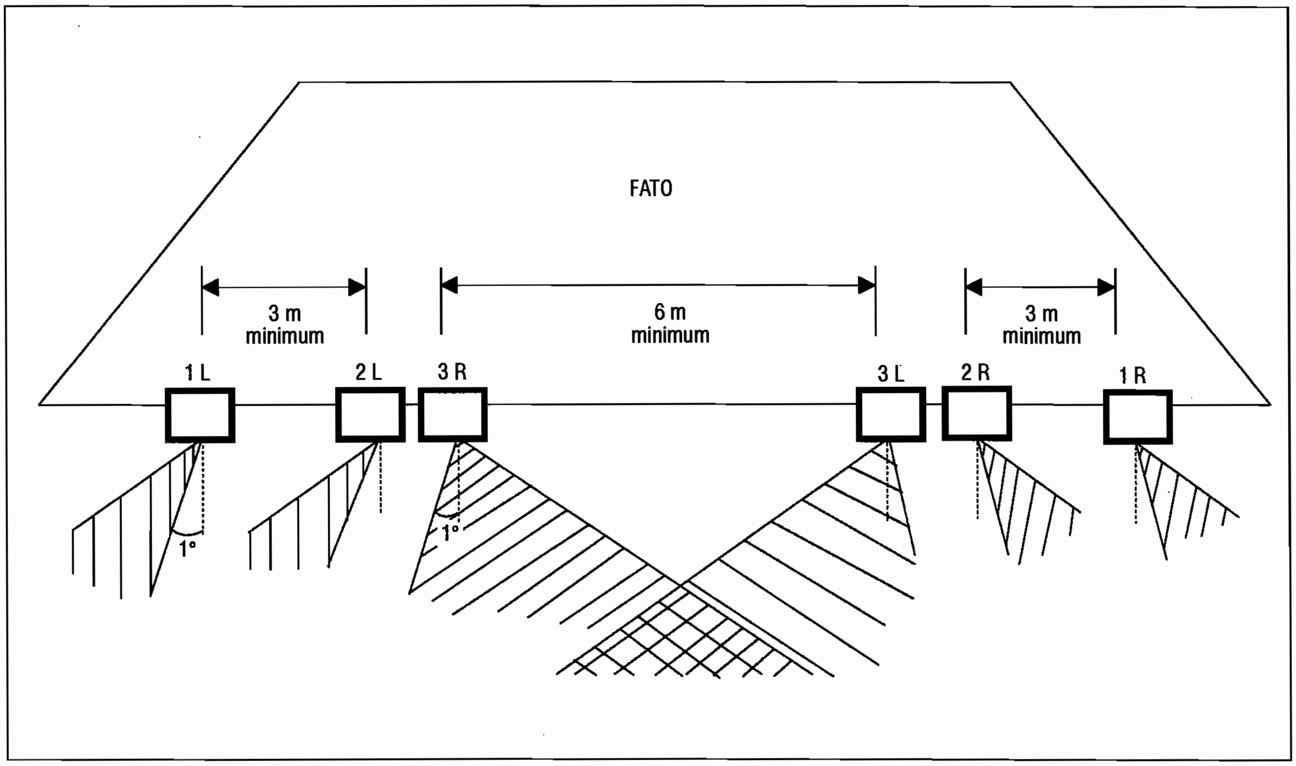


Figure 5-15. Siting of the alignment guidance system

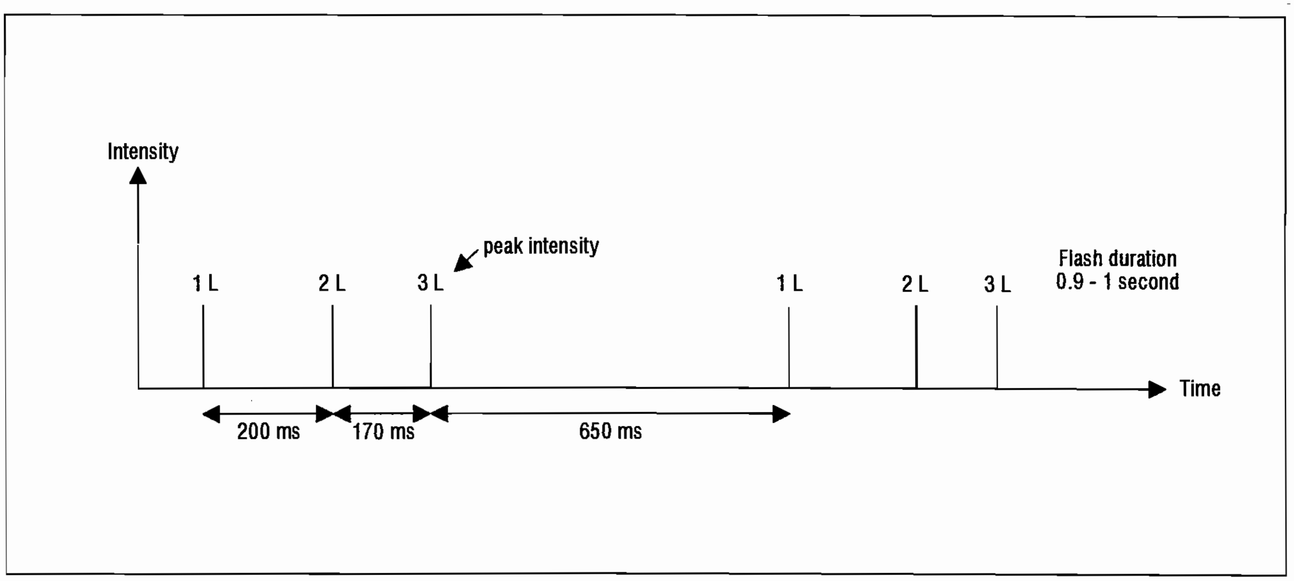


Figure 5-16. Offset sector flash characteristics

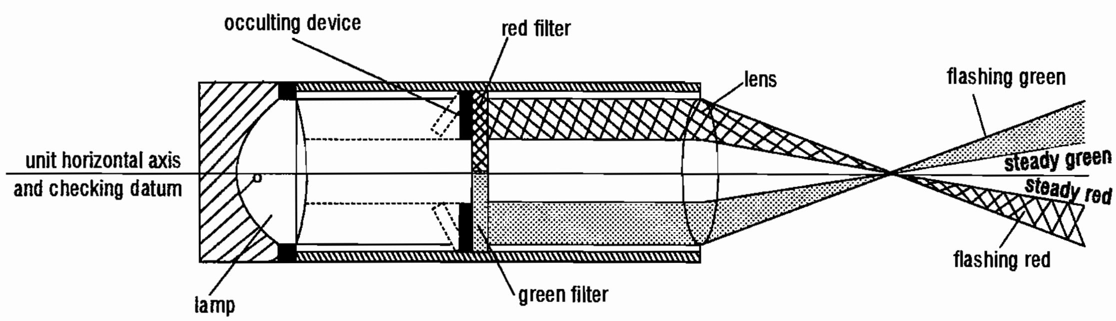


Figure 5-17. HAPI light unit

5.5.4.3 The HAPI units shall be so designed that in the event of a vertical misalignment exceeding ±0.5°, the system will switch off automatically.

5.5.5 Brilliancy

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

5.5.6 Mounting

5.5.6.1 Firm bases are essential for HAPI units as for any precision system. The design of the mounting should, therefore, be such as to provide maximum stability.

5.5.6.2 Where alternative approach sectors are required, the HAPI system may be installed on a turntable.

5.5.7 Frangibility and blast resistance

5.5.7.1 The HAPI systems shall be frangible and mounted and sited as low as possible so as not to constitute a hazard to helicopters.

5.5.7.2 The HAPI system shall maintain its setting angle when exposed to rotor downwash and environmental conditions.

5.5.8 Resistance to foreign matter

5.5.8.1 The HAPI shall be designed as a sealed unit so as to prevent the ingress of foreign matter and of formation of salt deposits on the lens systems.

5.5.8.2 The unit shall be constructed of materials resistant to corrosion.

5.5.9 Condensation and ice

Low-power heater elements (50 to 100 W) may be needed to prevent the formation of condensation and ice on the lenses of light units. Operation of light units at a lower power setting (20 W per lamp), when the unit is not in use, has also been shown to be a satisfactory method of prevention. Units which do not have some means of keeping the lens glasses warm need an adequate, full-intensity warm-up period before use to disperse condensation or remove ice from the lenses. The appropriate warm-up time for a HAPI unit must be established.

5.5.10 Initial flight inspection

A flight inspection of a new installation is recommended to confirm the correct operation of the system. The inspection should include checks of the azimuth coverage, range, setting angle, brilliancy control and compatibility with the ILS or MLS (if provided).

5.5.11 Routine inspection

5.5.11.1 The initial setting-up will be accomplished either by the manufacturer's agent or under strict compliance with the manufacturer's installation instructions. Thereafter, a suitable routine inspection schedule should be established to ensure that the system remains operationally safe.

5.5.11.2 A regular check should be made on HAPI systems to ensure that:

a) all lamps are lighted and illuminated evenly;

b) no evidence of damage is apparent;

c) the signal format is correct;

d) the change of signals is coincident for all optical elements in a HAPI unit;

e) the lenses are not contaminated; and

f) the control systems are operating properly.

5.5.12 Method of checking

The setting angle is checked using a clinometer or an equivalent means set to the appropriate angle and placed on the checking datum. Errors in excess of 3 minutes of arc should be corrected.

5.5.13 Layout and elevation setting angle

5.5.13.1 The HAPI unit shall be located as to avoid dazzling pilots at the final stages of the approach and landing. The minimum setting angle of HAPI is 1°. On a helideck where no obstacle-free sector is provided and on a surface level heliport or on an elevated heliport, HAPI should preferably be installed either on the left or on the right side of the final approach and take-off area. Sometimes it can be desirable to have it on the axis of the preferred approach. In those cases, the HAPI unit should be placed on the centre of the inner edge of the final approach and take-off area. When the system is located above the level of the touchdown and lift-off area its elevation should be determined by the appropriate authority.

5.5.13.2 At sites where HAPI does not provide a safe clearance at the final approach and take-off area edge, a warning should be provided in the appropriate aeronautical documents.

5.5.13.3 Examples of the use of HAPI with different sitings are illustrated in Figure 5-18.

5.5.13.4 When placed on a turntable, on an elevated heliport or a helideck, the HAPI system can be aligned to the desired approach axis.

5.5.13.5 When installed on a floating helideck, the beam of the HAPI should be stabilized to an accuracy of ±¼° within ±3° pitch and roll movement of the helideck.

5.5.14 Clearance from FATO

The HAPI unit shall be located 3 m outside the safety area and shall not penetrate any obstacle limitation surface.

5.5.15 Obstacle considerations

5.5.15.1 The location and approach angle of HAPI may be influenced by the presence of obstacles in the approach area. The area to be surveyed is shown in Table 5-1 and Figure 5-19.

5.5.15.2 Table 5-1 shows the dimensions and divergences of the obstacle protection surface for the three types of visual approach slope indicators meant for use at heliports. These surfaces are derived from the approach surfaces specified in Annex 14, Volume II, Chapter 4.

Table 5-1

Surface and dimensions	*Non-instrument FATO*	*Non-precision approach FATO*
Length of inner edge	Width of safety area	Width of safety area
Distance from end of FATO	3 m minimum	60 m
Divergence	10 per cent	15 per cent
Total length	2 500 m	2 500 m

5.5.15.3 The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the HAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.

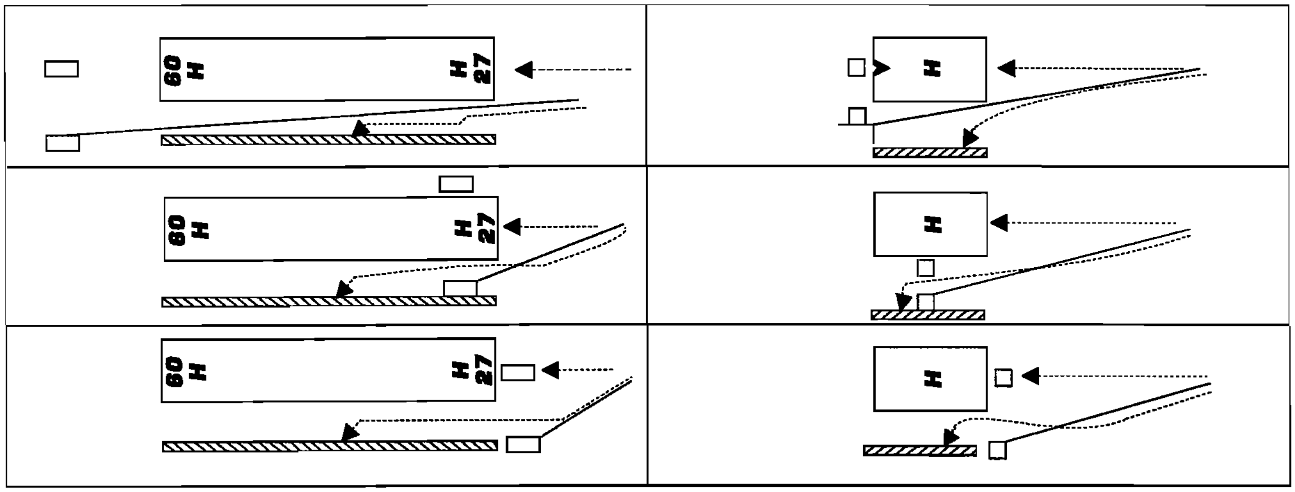


Figure 5-18. Examples of the use of HAPI with different sitings

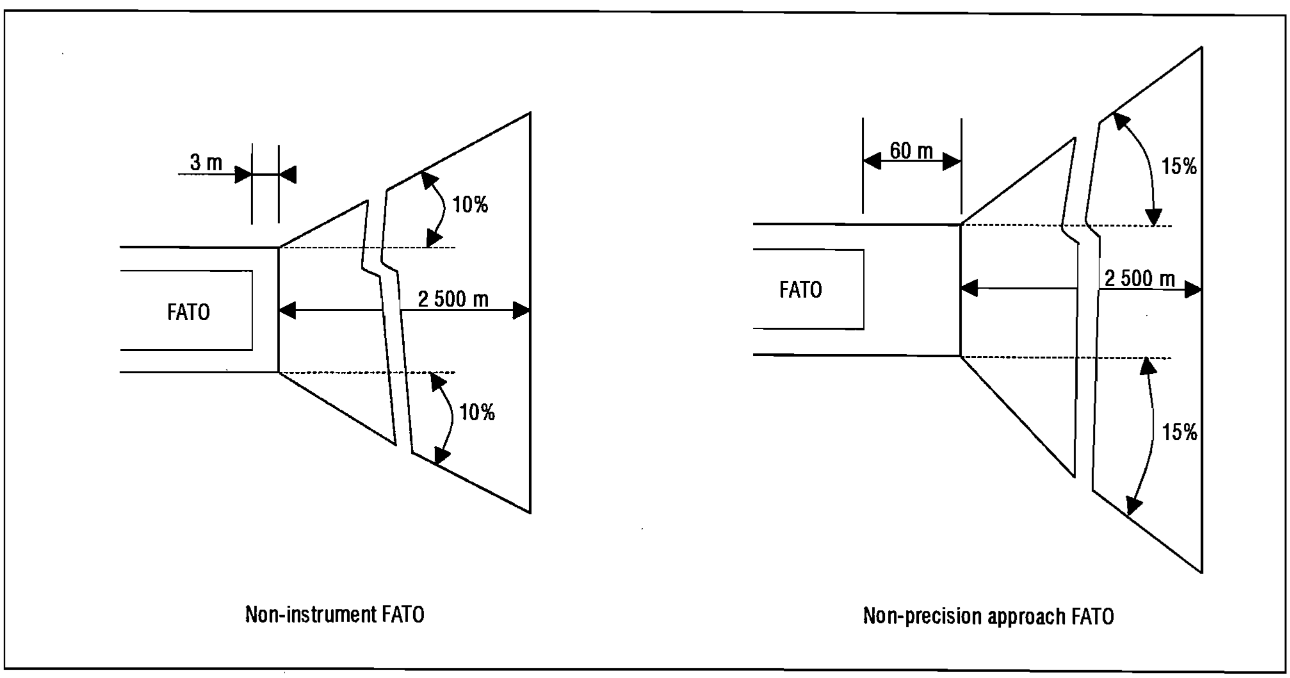


Figure 5-19. Area to be surveyed

Chapter 6

RESCUE AND FIRE FIGHTING

Note.— The material in 6.1 to 6.9 applies to surface level heliports and elevated heliports only. The International Maritime Organization (IMO) requirements for helicopter rescue and fire fighting operations are considered adequate for helidecks and are reproduced in 6.10.

SURFACE LEVEL AND ELEVATED HELIPORTS

6.1 INTRODUCTION

6.1.1 The principal objective of a rescue and fire fighting service is to save lives in the event of an aircraft accident or incident.

6.1.2 This must assume at all times the possibility of and need for extinguishing a fire which may:

a) exist at the time a helicopter is touching down, lifting off, taxiing, parked, etc.;

b) occur immediately following a helicopter accident or incident; or

c) occur at any time during rescue operations.

6.1.3 For this reason, the provision of adequate and special means of dealing promptly with an accident or incident occurring at, or in the immediate vicinity of, a heliport assumes primary importance because it is within this area that there are the greatest opportunities to save lives.

6.1.4 The most important factors bearing on effective rescue in a survivable helicopter accident are the training received, the effectiveness of the fire fighting equipment and the speed with which personnel and equipment designated for rescue and fire fighting purposes can be put into use.

6.1.5 When considering special arrangements to be made at heliports for fire protection and rescue, attention should be given to fire prevention and limitation aspects, particularly in relation to the location of the heliport with respect to the occupation of surrounding areas.

6.1.6 In general, the development of rescue and fire fighting (RFF) requirements for helicopters operating at heliports has been based on, and follows the same philosophy as that for aeroplanes at aerodromes. Practices different to the current ICAO requirements for RFF facilities at aerodromes have only been developed where necessary because the design or operating characteristics of the helicopter differ significantly from those of the aeroplane.

6.1.7 Although the amount of fuel carried by helicopters is generally less than that carried by aeroplanes, a more serious fire situation can occur as the fuel tank is located, in most cases, underneath the occupied portion of the fuselage and close to the engine. In other words, burning fuel in a helicopter crash is more likely to remain within the area adjacent to the helicopter and thus the resulting fire situation may be more serious than one involving an aeroplane of similar size.

6.1.8 The proposals set out hereunder concerning rescue and fire fighting services and equipment to be provided at heliports are based on specifications contained in Annex 14, Volume II.

6.1.9 Guidance material on all aspects of rescue and fire fighting services may be found in the *Airport Services Manual* (Doc 9137), Part I — *Rescue and Fire Fighting.* Diagrams showing helicopter data related to emergency situations are also given in that manual.

6.2 LEVEL OF PROTECTION

6.2.1 Except at an unattended heliport with a low movement rate, rescue and fire fighting services and equipment should be provided at a heliport. The level of protection to be provided should be based on the over-all length of the longest helicopters normally using the heliport.

6.2.2 The level of protection to be provided at an aerodrome (aerodrome RFF category) is based on the dimensions of the longest aeroplanes using the aerodrome but may be adjusted for their frequency of operation. Accordingly, when the number of movements of the longest aeroplanes during the busiest consecutive three months of the year is less than 700, the aerodrome category may be lower than that corresponding to the largest aeroplane. This factor (700 movements) is based on statistical data on aeroplane rescue and fire fighting operations. In the case of heliports, however, the level of protection (heliport RFF category) is based on the dimensions of the longest helicopters planned to use the heliport irrespective of their frequency of operations. This is for two reasons. Firstly, statistical data on helicopter accidents are not available. Secondly, the fire situation expected to be found at a helicopter crash, as explained in 6.1.7 above, may be more serious than one involving an aeroplane of similar size. Thus, it has been concluded that the level of protection should be based on the length of the longest helicopter normally using the heliport irrespective of its movement rates.

6.2.3 A study of helicopter sizes and their characteristics has shown that three fire fighting categories are sufficient to cover the range of commonly used helicopters. Categories are defined on the basis of helicopter over-all length, i.e. including the tail boom and rotors. It was initially considered that for helicopters it would be desirable to use the length of the fuselage instead of the over-all length since the rotors should not normally be a factor to be taken into account for rescue and fire fighting purposes. The occupied portion of a helicopter was even considered more significant than fuselage length. However, information on the occupied portion is not readily available and for purposes of standardization it is desirable to use the same method of categorization as is used for aeroplanes, namely the over-all length.

6.2.4 The level of protection to be provided at a heliport (heliport RFF category) is determined from Table 6-1 appropriate to the over-all length of the longest helicopter normally using the heliport irrespective of its frequency of operations. However, during anticipated periods of operations by smaller helicopters, the heliport fire fighting category may be reduced to that of the highest category of helicopter planned to use the heliport at that time. For convenience the table in Appendix 1 contains the heliport fire fighting category for representative helicopters.

Table 6-1. Heliport fire fighting category

Category	*Helicopter over-all length*[1]
H1	up to but not including 15 m
H2	from 15 m up to but not including 24 m
H3	from 24 m up to but not including 35 m

1. Helicopter length, including the tail boom and the rotors

6.2.5 In the case of a heliport located on an aerodrome for use by aeroplanes, the rescue and fire fighting facilities provided for aeroplanes will normally be suitable for the protection of the helicopters. This assumes that the rescue and fire fighting services and equipment provided for aeroplanes will be at least equal to those required for the longest helicopters normally using the facility and that the response time to the heliport does not exceed two minutes.

6.3 TYPES OF EXTINGUISHING AGENTS

6.3.1 *General.* As for an aerodrome, both principal and complementary agents should be provided at a heliport, as shown in Tables 6-2 and 6-3. Principal agents provide a permanent control, i.e. for a period of several minutes or longer. Complementary agents have rapid fire suppression capability but provide control only during application and for a short period thereafter. Characteristics of the recommended extinguishing agents may be found in the *Airport Services Manual* (Doc 9137), Part I — *Rescue and Fire Fighting*, Chapter 8.

6.3.2 *Principal agents.* For the reason mentioned in 6.1.7 above, survival time in a helicopter crash may be less than in an aeroplane crash and thus a very quick fire suppression capability is required. Consequently, only foams meeting performance level B, which have quicker fire suppression capabilities than foams meeting performance level A, are recognized as principal agents.

6.3.3 *Quality of foams.* The quality of a foam produced by a rescue and fire fighting vehicle using any concentrate-type will significantly affect the control and extinguishment times of an aircraft fire. Functional fire tests are required to determine the suitability of a foam concentrate in an airport environment. Paragraph 8.1.5 in the *Airport Services Manual* (Doc 9137), Part I — *Rescue and Fire Fighting* lists the minimum specifications for foams produced from

Table 6-2. Minimum usable amounts of extinguishing agents for surface level heliports

	Foam meeting performance Level B		*Complementary agents*		
Category	*Water (L)*	*Discharge rate foam solution (L/min)*	*Dry chemical powders (kg)* or	*Halons (kg)* or	*CO_2 (kg)*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
H1	500	250	23	23	45
H2	1 000	500	45	45	90
H3	1 600	800	90	90	180

Table 6-3. Minimum usable amounts of extinguishing agents for elevated heliports

	Foam meeting performance Level B		*Complementary agents*		
Category	*Water (L)*	*Discharge rate foam solution (L/min)*	*Dry chemical powders (kg)* or	*Halons (kg)* or	*CO_2 (kg)*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
H1	2 500	250	45	45	90
H2	5 000	500	45	45	90
H3	8 000	800	45	45	90

protein, synthetic, fluoroprotein, film forming fluoroprotein and aqueous film forming concentrates. The specifications include physical properties and the performance of the foams under fire test conditions. Any foam concentrate to be used in heliport rescue and fire fighting vehicles should meet or exceed the criteria in these specifications, so as to achieve performance level B.

6.3.4 Where States or individual users do not have the facilities for conducting the tests which will establish the specified properties and performances, certification of the qualification of a concentrate should be obtained from the manufacturer or supplier, based on the local operating conditions.

6.3.5 *Complementary agents.* With respect to complementary agents, the three types recommended in Annex 14, Volume I, for use at aerodromes, i.e. dry chemical powder, halons or CO_2, are considered suitable for use at heliports. However, dry chemical powder and halons are normally considered more efficient than CO_2 for aircraft rescue and fire fighting operations. Also, at elevated sites the effectiveness of CO_2 may be reduced, as the agent may be rapidly dispersed by the windy conditions that often prevail at such sites.

6.3.6 When selecting dry chemical agents for use with foam, care must be exercised to ensure compatibility.

6.4 FIRE PROTECTION CONCEPT

The method for the determination of rescue and fire fighting requirements for aeroplanes is based on the concept of a critical area to be protected in any post-accident fire situation to permit the evacuation of the aeroplane occupants. This concept was advocated by the Rescue and

Fire Fighting Panel in 1970 and subsequently adopted by ICAO for the calculation of the amounts of extinguishing agents required to control and extinguish aeroplane fires. In the case of aeroplanes, the critical area is based on the average aeroplane length and width for each aerodrome RFF category. The quantities of water needed for foam production and the prescribed discharge rates are proportional to this critical area. A similar concept has been developed for the rescue and fire fighting requirements for helicopters.

6.5 CRITICAL AREA FOR HELIPORTS

6.5.1 The critical area is defined as the area adjacent to a helicopter in which fire must be controlled for the purpose of ensuring temporary fuselage integrity and providing an escape area for occupants of the helicopter.

6.5.2 The critical area is a rectangle having as one dimension an average helicopter fuselage length and as the other dimension:

a) for helicopters with a fuselage length less than 24 m, an average fuselage width plus 4 m; and

b) for helicopters with a fuselage length of 24 m or more, an average fuselage width plus 6 m.

The size of the critical area can thus be expressed as: $L \times (W + W_1)$ where:

L = Average fuselage length
W = Average fuselage width
W_1 = Additional width factor, i.e. 4 or 6 m.

The additional width factor is intended to take into account other considerations such as the amounts of fuel carried and its location in helicopters. Actual calculation of the critical area is contained in Table 6-4.

6.6 AMOUNTS OF EXTINGUISHING AGENTS

6.6.1 *Principal agents.* The amounts of water for foam production to be provided at a heliport should be in accordance with the heliport RFF category (Table 6-1) and Table 6-2 and 6-3 as appropriate. The amounts in Table 6-2 or 6-3 are the minimum amounts of extinguishing agents to be provided. Wherever possible it is desirable to provide additional protection, bearing in mind the recurrent maintenance needs of equipment, and/or any unusual operational hazards particular to a heliport. The amounts of extinguishing agents to be provided and the discharge rates at which they are to be applied have been determined in principle by the same method used for aeroplanes.

6.6.2 As mentioned in 6.5 above, the critical area requires protection from the effects of fire in order that the occupants of the helicopter can either evacuate or be rescued. The amounts of water are calculated by using the critical area for the heliport RFF category multiplied by the standard rate of application and by the time of application. Although for the purpose of determining the heliport RFF category the over-all length of the helicopter has been used, an average fuselage length has been used to determine the critical area for each category.

6.6.3 The amounts of water specified for foam production are predicated on a standard application rate of 5.5 L/min/m^2. This application rate is the same as that recommended by the Rescue and Fire Fighting Panel and subsequently adopted by ICAO for aeroplane fires and is considered to be the optimum rate at which control of the fire can be achieved within one minute. The amount of the foam compound to be provided is in proportion to the recommended quantity of water for foam production and the foam concentrate selected.

6.6.4 The discharge rate of the foam solution should not be less than the rates shown in Table 6-2 or 6-3. The discharge rate given in these tables is the rate required to obtain a one-minute control time over the critical area. It is determined for each heliport RFF category by multiplying the critical area by the application rate.

6.6.5 To permit helicopter occupants either to evacuate or be rescued, the amounts of water to be provided are based on the assumption of a fire attack lasting approximately 2 minutes at a surface level heliport and 10 minutes at an elevated heliport.

6.6.6 The purpose of the extended fire attack period for an elevated heliport is to permit protection of the entire helipad from the effects of fire in order to protect the very limited routes of escape. In the case of an elevated heliport it is also considered essential to ensure that the agents can be applied to the entire helipad irrespective of the wind direction.

6.6.7 The amounts of water specified for elevated heliports do not have to be stored on or adjacent to the helideck if there is a suitable adjacent pressurized water-main capable of sustaining the required discharge rate. It is to be noted that requirements to protect any building or structure on which a heliport is located are not taken into account.

Table 6-4. Calculation of critical area and amounts of water needed for foam production

	Helicopter fire fighting category		
	H1	*H2*	*H3*
Determination of critical area			
Over-all helicopter length			
lower limit (m)	0	15	24
upper limit (m)	≤15	≤24	≤35
Average helicopter fuselage length (m)	8.5	14.5	17
Average helicopter fuselage width (m)	1.5	2	2.5
Additional width factor W_1 (m)	4	4	6
Critical area (m^2)	47	87	144
Application rate ($L/min/m^2$)	5.5	5.5	5.5
Discharge rate — foam solution (L/min)	250	500	800
Water needed for foam production			
Surface-level heliport (L)	500	1 000	1 600
Elevated heliport (L)	2 500	5 000	8 000

6.6.8 Table 6-4 shows the calculations of the critical area (as explained in 6.5.2) and associated amounts of water for foam production for each heliport category. The critical area has been determined by using as the average fuselage length and width, the arithmetic mean of actual fuselage lengths and widths of commonly used civilian helicopters for each category. These values have been rounded to the closest five tenths of the whole number. The values for the amounts of water have been rounded to the closest hundred.

6.6.9 *Complementary agents.* The amounts of complementary agents to be provided at a heliport are related to the heliport RFF category and the heliport site. As for aeroplane fires, the discharge rates should be selected for optimum effectiveness of the agent used.

6.6.10 *Agent substitution.* For a surface level heliport it is permissible to replace all or part of the amount of water for foam production by complementary agents.

6.6.11 For the purpose of replacing water for foam production by complementary agents the following equivalents should be used:

1 kg dry chemical powder or 1 kg halon or 2 kg CO_2	=	0.66 L water for production of a foam meeting performance level B

Higher equivalencies for complementary agents may be used if results of tests conducted on the complementary agents used by the State have indicated higher efficiencies than those recommended above.

6.7 RESPONSE TIME

6.7.1 Response time is considered to be the time between the initial call to the rescue and fire fighting service and the time when the first responding vehicle(s) (the service) is (are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table 6-2.

6.7.2 At a surface level heliport, the operational objective of the rescue and fire fighting service should be to achieve response times not exceeding two minutes in optimum conditions of visibility and surface conditions.

6.7.3 In the case of an elevated heliport, no specific response time is recommended as it is considered that the rescue and fire fighting service will be available on or in the immediate vicinity of the heliport while helicopter operations are taking place.

6.8 SPECIAL PROVISIONS RELATED TO ELEVATED HELIPORTS

6.8.1 Particular problems arise from the operation of helicopters at elevated heliports that require special attention with regard to the rescue and fire fighting provisions. One important aspect is the confined and restricted space available on the average elevated heliport. This will impose restrictions on foam monitor positioning and general fire fighting tactics. It is feasible that an accident could result in a fuel spill and a fire situation that could quickly cut off or reduce the already limited routes of escape to a place of safety for the occupants of the helicopter. In addition, the accident or fire may involve rescue and fire fighting facilities located adjacent to the elevated heliport. As a result, as shown in Table 6-3, the requirement for the amounts of extinguishing agents at elevated heliports is based on a fire fighting action which may be required to last much longer than at surface level heliports. In addition, at an elevated heliport the rescue and fire fighting service should be immediately available on or in the vicinity of the heliport while helicopter movements are taking place.

6.8.2 At an elevated heliport, at least one hose spray line capable of delivering foam in a jet spray pattern at 250 L/min should be provided. This calls for the provision at a heliport category H1 of a hose line equipped with a nozzle capable of discharging foam/water in a straight stream (jet) and/or a dispersed pattern (fog/spray).

6.8.3 It is also considered essential at an elevated heliport to be able to apply the fire fighting agents, both principal and complementary, to any part of the heliport irrespective of the wind direction. To achieve this and to overcome the possibility of a monitor being involved in the accident, it is necessary that at elevated heliports in categories 2 and 3, at least two monitors be provided each having a capability of achieving the required discharge rate, and positioned at different locations around the heliport so as to ensure the application of foam to any part of the heliport under any weather condition. To further ensure the application of the agents to any part of the heliport under any weather condition, the monitors should preferably be operable from two remote control positions located clear of the heliport and easily accessible.

6.9 RESCUE EQUIPMENT

Rescue equipment commensurate with the level of helicopter operations should be provided as shown in Table 6-5. At an elevated heliport the rescue equipment should be stored adjacent to the helideck.

6.10 INTERNATIONAL MARITIME ORGANIZATION (IMO) PRACTICE* FOR HELIDECKS

On any helicopter deck there should be provided and stored near to the means of access to that deck:

a) at least two dry powder extinguishers having a total capacity of not less than 45 kg;

b) a suitable foam application system consisting of monitors or foam-making branch pipes capable of delivering foam solution to all parts of the helicopter deck at a rate of not less than 6 L/min for at least 5 min for each square metre of the area contained within a circle of diameter "D", where "D" is the distance in metres across the main rotor and across both rotors for a tandem rotor helicopter. The administration may accept other fire-fighting systems which provide a fire-extinguishing capability at least as effective as the required foam application system;

c) carbon dioxide extinguishers of a total capacity of not less than 18 kg or equivalent, one of these extinguishers being so equipped as to enable it to reach the engine area of any helicopter using the deck; and

d) at least two dual purpose nozzles and hoses sufficient to reach any part of the helicopter deck.

* Extracted from IMO document entitled "Code for the Construction and Equipment of Mobile Offshore Drilling Units; 1989 (1989 MODU CODE)".

Table 6-5. Rescue equipment

Equipment	*Heliport HF category* *H1 and H2*	*H3*
Adjustable wrench	1	1
Axe, rescue, non-wedge or aircraft type	1	1
Cutters, bolt, 60 cm	1	1
Crowbar, 105 cm	1	1
Hook, grab or salving	1	1
Hacksaw, heavy duty complete with 6 spare blades	1	1
Blanket, fire resistant	1	1
Ladder, length appropriate to helicopters in use	–	1
Lifeline, 5 cm, 15 m in length	1	1
Pliers, side cutting	1	1
Set of assorted screwdrivers	1	1
Harness knife complete with sheath	1	1
Gloves, fire resistant	2 pairs	3 pairs
Power cutting tool	–	1

Chapter 7

HELIPORT DATA

7.1 GEOGRAPHICAL COORDINATES

7.1.1 Geographical coordinates indicating latitude and longitude shall be determined and reported to the aeronautical information services authority in terms of the World Geodetic System — 1984 (WGS-84) geodetic reference datum, identifying those geographical coordinates which have been transformed into WGS-84 coordinates by mathematical means and whose accuracy of original field work does not meet the requirements in 2.1.2 below.

7.1.2 The order of accuracy of the field work shall be such that the resulting operational navigation data for the phases of flight will be within the maximum deviations, with respect to an appropriate reference frame, as indicated herein:

a) significant obstacles on and in the vicinity of the heliport and positions of radio navigation aids located on the heliport: three metres;

b) geometric centre of the touchdown and lift-off area, thresholds of the final approach and take-off area (where appropriate): one metre;

c) centre line points of the helicopter ground taxiways, air taxiways and air transit routes and helicopter stands: one-half metre; and

d) heliport reference point: thirty metres.

Note 1.— An appropriate reference frame is that which enables WGS-84 to be realized on a given heliport and with respect to which all coordinate data are related.

Note 2.— Specifications governing the publication of WGS-84 coordinates are given in Annex 4, Chapter 2 and Annex 15, Chapter 3.

7.2 HELIPORT REFERENCE POINT

7.2.1 A heliport reference point shall be established for a heliport not co-located with an aerodrome.

Note.— When the heliport is co-located with an aerodrome, the established aerodrome reference point serves both aerodrome and heliport.

7.2.2 The heliport reference point shall be located near the initial or planned geometric centre of the heliport and shall normally remain where first established.

7.2.3 The position of the heliport reference point shall be measured and reported to the aeronautical information services authority in degrees, minutes and seconds.

7.3 HELIPORT ELEVATION

7.3.1 The heliport elevation shall be measured and reported to the aeronautical information services authority to the nearest metre or foot.

7.3.2 For a heliport used by international civil aviation, the elevation of the touchdown and lift-off area and/or the elevation of each threshold of the final approach and take-off area (where appropriate) shall be measured and reported to the aeronautical information services authority to the nearest metre or foot.

7.4 HELIPORT DIMENSIONS AND RELATED INFORMATION

7.4.1 The following data shall be measured or described, as appropriate, for each facility provided on a heliport:

a) heliport type — surface-level, elevated or helideck;

b) touchdown and lift-off area — dimensions, slope, surface type, bearing strength in tonnes (1 000 kg);

c) final approach and take-off area — type of FATO, true bearing, designation number (where appropriate), length, width, slope, surface type;

d) safety area — length, width and surface type;

e) helicopter ground taxiway, air taxiway and air transit route — designation, width, surface type;

f) apron — surface type, helicopter stands;

g) clearway — length, ground profile; and

h) visual aids for approach procedures, marking and lighting of FATO, TLOF, taxiways and aprons.

7.4.2 The geographical coordinates of the geometric centre of the touchdown and lift-off area and/or of each threshold of the final approach and take-off area (where appropriate) shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

7.4.3 The geographical coordinates of appropriate centre line points of helicopter ground taxiways, air taxiways and air transit routes shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

7.4.4 The geographical coordinates of each helicopter stand shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

7.4.5 The geographical coordinates of significant obstacles on and in the vicinity of a heliport shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation rounded up to the nearest metre or foot, type, marking and lighting (if any) of the significant obstacles shall be reported to the aeronautical information services authority.

7.5 DECLARED DISTANCES

7.5.1 The following distances shall be declared, where relevant, for a heliport:

a) take-off distance available;

b) rejected take-off distance available; and

c) landing distance available.

7.5.2 Take-off distance available shall be the measured distance of the length of the FATO, which must be completely free of obstacles, plus the measured length of any clearway provided. The clearway is measured from the end of the FATO as far as the nearest upstanding obstacle in the direction of take-off, within the required width. Within the clearway, lightweight and/or frangible objects only will be permitted.

7.5.3 Rejected take-off distance available shall be the measured distance of the length of the FATO which includes the distance which is declared available and suitable for performance class 1 helicopters to safely complete a rejected take-off. The RTODAH must have a surface which is resistant to the effects of rotor downwash, be free of irregularities which could affect the safe landing of helicopters and have bearing strength sufficient to accommodate the rejected take-off by performance class 1 helicopters.

7.5.4 Landing distance available shall be the measured distance of the length of the FATO plus the length of any additional area declared available and suitable for helicopters to complete the landing manoeuvre from a height of 30 m (100 ft). The surface of the additional area must have the same characteristics as the FATO.

7.6 RESCUE AND FIRE FIGHTING

It is recommended that information concerning the level of protection provided at a heliport for helicopter rescue and fire fighting be made available. The level of protection should be expressed in terms of the Category of rescue and fire fighting services as described in Annex 14, Volume II, Chapter 6, Table 6-1.

Appendix 1. HELICOPTER CHARACTERISTICS

(see Figures A1-1 and A1-2)

Company	Model designation	A Rotor diameter (m)	B Length over-all	C Length fuselage (m)	D Width fuselage (m)	E Height (m)	F1 Tread forward (m)	F2 Tread aft (m)	G Wheel base (m)	Maximum gross weight (kg)	Engines	No. of seats Crew	No. of seats Pass.	Fuel cap. (L)	RFF cat.
1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
ARDC/Brantly	B-2	7.21	6.62	5.50	1.27	2.13	1.72	1.72	*	726	1	1	1	114	1
	B-2B	7.24	8.53	6.62	1.27	2.06	1.73	1.73	*	757	1	1	1	117	1
	305	8.74	10.03	7.44	1.39	2.44	–	2.10	2.15	1 315	1	1	4	163	1
ARDC/Omega	RP-440	11.71	14.73	**	**	3.92	–	4.19	**	2 336	2	1	2-3	288	1
Aerospatiale	Alouette						2.08	2.08	3.06#						
	II	10.02	12.05	9.70	2.08	2.75	2.30	2.30	8.87#	1 500	1	1	4	580	1
	Alouette III	11.00	12.82	10.18	2.60	2.97	–	2.59	3.40	2 100	1	1	6	595	1
	Djinn 1221	11.00	11.00	5.31	1.95	2.62	–	1.93	2.10	760	1	1	1	250	1
	SA-315B	11.02	12.91	10.23	2.60	3.09	2.38	2.38	*	1 750	1	1	4	575	1
	SA-316B	11.02	12.84	10.18	2.60	2.97	–	2.60	3.20	2 200	1	1	6	575	1
	SA-318C	10.21	12.09	9.75	2.08	2.74	2.38	2.38	*	1 655	1	1	4	580	1
	SA-319B	11.02	12.84	10.18	2.60	3.00	–	2.60	3.20	2 250	1	1	6	573	1
	SA-330J	15.08	18.22	14.82	1.80	5.14	0.48	3.00	4.05	7 400	2	2-3	8-20	1 544	2
	SA-341G	10.50	11.97	9.53	1.32	3.19	2.02	2.02	2.29	1 800	1	1-2	3	735	1
	AS-350	10.69	12.94	10.91	1.80	3.14	2.17	2.17	*	1 950	1	1-2	4	540	1
	SA-360C	11.50	13.20	10.98	1.96	3.50	1.95	–	7.23	3 000	1	1-2	8	475	1
	SA-365C	11.68	13.29	10.98	1.96	3.54	1.95	–	7.23	3 400	2	1-2	8	475	1
	AS-355F1	10.69	12.99	10.91	1.80	3.15	2.10	2.10	*	2 400	2	2	4	730	1
	AS-332C	15.60	18.70	14.76	3.79	4.92	–	3.00	4.49	9 000	2	2	17	1 497	2
	AS-332L1	15.60	18.70	15.52	3.79	4.92	–	3.00	5.28	8 600	2	2	24	2 020	2
Aerotecnica	AC-12	8.50	8.30	7.55	1.22	3.10	2.00	–	3.50	820	1	1	1	100	1
	AC-14	9.60	10.00	8.13	**	3.10	2.00	–	3.50	1 350	1	1	4	244	1

Company	Model designation	A Rotor diameter (m)	B Length over-all	C Length fuselage (m)	D Width fuselage (m)	E Height (m)	F1 Tread forward (m)	F2 Tread aft (m)	G Wheel base (m)	Maximum gross weight (kg)	Engines	No. of seats Crew	No. of seats Pass.	Fuel cap. (L)	RFF cat.
1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
Augusta	A101H	20.40	24.60	19.20	2.50	6.55	0.44	4.40	5.24	12 900	3	2-3	36	2 160	3
	102	14.50	17.92	12.73	2.70	3.23	2.45	2.45	*	2 850	1	1	9	**	2
	103	7.40	10.00	6.13	1.54	2.23	1.54	1.54	*	460	1	1	**	**	1
	104	7.95	9.30	6.35	**	2.35	1.64	1.64	*	640	1	2	**	**	1
	115	11.33	13.30	9.90	1.52	2.94	2.29	2.29	*	1 390	1	**	**	**	1
	A109A	11.00	13.05	10.71	1.42	3.30	–	2.30	3.53	2 450	2	1-2	6	560	1
	A109C	11.00	13.05	10.71	1.42	3.30	–	2.30	3.53	2 720	2	1-2	6	560	1
	AB205	14.63	17.45	12.70	2.39	3.91	2.64	2.64	*	4 310	1	1-2	14	**	2
	AB206BIII	10.16	11.91	8.65	1.27	2.80	1.83	1.83	*	1 451	1	1	4	288	1
	AB212	14.63	17.46	12.70	2.39	3.91	2.64	2.64	*	5 800	2	1	14	813	2
	HH-3F	18.89	22.25	17.44	1.98	5.50	–	4.06	5.21	10 002	2	2	25	2 430	2
Bell	47J	11.33	13.21	9.87	1.52	2.83	2.28	2.28	*	1 293	1	1	3	182	1
	47G	11.27	13.10	9.87	1.52	2.83	2.29	2.29	*	1 340	1	1	2	227	1
	47J-2	11.27	13.10	9.87	1.52	2.90	2.14	2.14	*	1 340	1	1	3	180	1
	47G-2	10.72	12.63	9.27	1.52	2.87	2.28	2.28	*	1 130	1	1	2	155	1
	47G-3B-2	11.30	13.15	9.90	1.52	2.84	2.28	2.28	*	1 340	1	1	2	216	1
	47G-4A	11.30	13.15	9.90	1.52	2.84	2.28	2.28	*	1 340	1	1	2	216	1
	47G-5	11.30	13.15	9.90	1.52	2.84	2.28	2.28	*	1 340	1	1	2	216	1
	204	13.41	16.15	13.00	2.39	3.43	2.54	2.54	*	3 270	1	1	5	625	2
	204B	14.61	17.40	12.98	2.39	4.42	2.59	2.59	*	3 860	1	1	9	625	2
	205A	14.61	17.41	12.77	2.39	4.42	2.75	2.75	*	2 150	1	1	14	815	2
	205A-1	14.63	17.40	12.65	2.39	4.39	**	**	*	*	1	1	14	814	2
	206	10.21	11.28	8.28	1.27	2.64	1.77	1.77	*	1 310	1	1	4	288	1
	206A	10.20	11.80	9.50	1.27	2.93	1.92	1.92	*	1 360	1	1	4	288	1
	206B	10.16	11.82	8.63	1.27	2.91	1.95	1.95	*	1 451	1	1	4	344	1
	206L1	11.28	12.92	9.27	1.27	3.14	2.26	2.26	*	1 814	1	2	5	371	1
	206L-3	11.28	13.02	9.57	1.32	3.14	2.34	2.34	*	1 882	1	2	5	416	1
	212/UH-IN	14.69	17.46	12.92	2.39	3.93	2.86	2.86	*	5 080	2	1-2	14	814	2
	214B	15.24	18.35	13.44	2.39	4.22	2.84	2.84	*	6 260	2	1-2	15	773	2
	214ST	15.85	18.95	15.24	2.86	4.84	2.64	2.64	*	7 938	2	2	18	1 647	2
	222	12.12	14.53	10.98	1.41	3.93	–	2.77	3.59	3 470	2	1-2	6-10	617	1
	222UT	12.80	15.20	12.85	3.18	3.51	–	2.77	3.59	3 742	2	2	6	908	2
	412	14.02	17.07	12.92	2.86	4.32	2.59	2.59	*	5 397	2	1	14	1 249	2
	230	12.80	15.38	12.97	**	3.66	2.39	2.39	*	3 810	2	1	8	931	1

Company	Model designation	A Rotor diameter (m)	B Length over-all	C Length fuselage (m)	D Width fuselage (m)	E Height (m)	F1 Tread forward (m)	F2 Tread aft (m)	G Wheel base (m)	Maximum gross weight (kg)	Engines	No. of seats Crew	No. of seats Pass.	Fuel cap. (L)	RFF cat.
1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
Boeing-Vertol	107	14.63	24.89	13.59	2.51	5.13	–	4.24	7.55	7 550	2	2	25	**	3
	107 II	15.22	25.50	**	2.51	5.13	–	4.42	7.62	8 610	2	2	25	1 360	3
	CH-46E	15.54	25.70	13.92	1.83	5.10	–	3.92	7.57	10 569	2	2	25	1 438	3
	YUH-61A	14.94	18.19	15.82	2.18	4.95	–	2.34	4.70	8 482	2	**	**	**	2
	CH-47C	18.29	30.12	15.54	2.51	5.69	3.20	3.20	6.86	22 680	2	2-3	33-44	4 137	3
	234LR	18.29	30.18	15.87	4.78	5.68	3.20	3.20	7.87	22 000	2	2	44	7 949	3
Changhe	CAF Z-8	18.90	23.04	**	6.66	**	**	**	**	10 592	**	2-3	39	3 900	3
Daman	LZ5-2	14.63	19.18	11.58	1.52	4.90	2.28	–	2.97	2 360	1	**	**	**	2
EHI	EH 101	18.59	22.81	**	4.52	6.65	**	**	**	14 288	3	2	30	**	3
Enstrom	F28A	9.75	8.90	8.56	1.55	2.75	2.10	2.10	*	975	1	1	2	114	1
	280C/F	9.75	8.43	8.56	1.55	2.79	2.24	2.24	*	1 179	1	1	2	151	1
	280FX	9.75	8.92	8.56	1.55	2.79	2.21	2.21	*	1 179	1	1	2	151	1
	480	9.75	8.92	8.56	1.55	2.90	2.46	2.46	*	1 225	1	1	3-4	**	1
Eurocopter	AS 332LZ	16.20	19.50	**	3.86	4.97	–	3.00	5.28	9 150	2	1-2	19	2 020	2
	AS 355N	10.69	12.99	10.91	1.80	3.15	2.10	2.10	*	2 540	2	2	2-4	730	1
	AS 365NZ	11.94	13.68	11.63	3.21	3.52	–	1.90	3.61	4 250	2	1-2	8-9	1 135	1
	BK 117	11.00	13.00	9.91	1.60	3.36	2.50	2.50	*	3 350	2	1	6-7	697	1
	BD 105	9.80	11.90	8.56	1.27	2.98	2.40	2.40	*	2 000	2	1-2	3-5	570	1
	BO 105CB	9.84	11.86	8.56	1.27	3.80	2.53	2.53	*	2 500	2	1-2	3-5	570	1
	BO 105CBS	9.84	11.86	8.81	1.27	3.80	2.53	2.53	*	2 500	2	1-2	3-5	570	1
	BO 105LS	9.84	11.86	8.56	1.27	3.02	2.53	2.53	*	2 500	2	1-2	3-4	570	1
	BO 108	10.20	10.64	9.68	1.50	3.06	2.20	2.20	*	2 500	2	1	4-6	**	1
	P 120L	10.70	**	12.22	2.80	3.06	**	**	*	2 000	1	1	4	600	1
Hiller	12-C	10.67	12.34	8.97	**	2.97	2.33	2.33	*	1 130	1	1	3	**	1
	UH-12E,E4	10.80	14.34	8.69	1.50	2.99	2.16	2.16	*	1 270	1	1	3	174	1
	UH-12E,4T	10.80	12.41	9.08	1.50	3.08	2.29	2.29	*	1 406	1	1	3	174	1
	FH-1100	10.80	12.60	8.56	1.31	2.80	2.20	2.20	*	1 247	1	1	4	255	1
	RH-1100S	**	**	9.08	**	2.79	2.20	2.20	*	1 587	1	1-2	5-6	259	1

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1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
Kaman	K-600	14.33	14.33	7.67	1.60	4.75	2.11	2.54	2.49	4 400	1	2	10	750	1
	K-700	14.33	17.80	12.75	**	4.00	1.91	2.54	**	3 800	2	4	8	2 540	2
	Ka-126	13.00	**	7.75	**	4.15	0.90	2.56	3.48	3 250	1	1	4-6	800	**
	Ka-32	15.90	**	11.30	4.00	5.40	1.40	3.50	3.02	11 000	2	2	16	**	2
	Ka-62	13.00	15.05	12.80	3.00	3.70	–	2.50	4.73	5 850	2	1-2	14	1 150	2
	Ka-118	11.00	**	10.00	**	2.60	2.60	2.60	*	2 150	1-2	1	4	700	1
	Ka-226	13.00	**	8.10	3.22	4.15	0.90	2.56	3.48	3 400	2	1	7	870	1
Kawasalo	47G3B-KH4	11.32	13.30	8.99	1.52	2.88	2.29	2.29	*	1 293	1	1	3	208	1
	369HS/ 369HM	8.03	9.24	7.01	1.30	2.59	2.07	2.07	*	1 157	1	1	3	232	1
	KV 107 II A	15.24	25.40	13.58	2.51	5.13	–	3.94	7.60	9 707	2	2	25	1 324	3
McDonnell Douglas	MD269A	7.62	8.63	6.79	1.30	2.41	1.98	1.98	*	700	1	1	2	95	1
	MD269 & 300	7.61	8.54	6.80	1.30	2.44	1.98	1.98	*	758	1	1	2	95	1
	MD500Exec	8.05	9.20	7.01	1.37	2.50	1.85	1.85	*	1 155	1	1	3	242	1
	MD500D	8.05	9.30	7.10	1.37	2.70	2.10	2.10	*	1 361	1	1	4-6	240	1
	MD500E	8.05	8.61	7.49	**	2.67	1.91	1.91	*	1 361	1	1	4-6	232	1
	MD500F	8.35	8.97	7.49	**	2.67	1.91	1.91	*	1 406	1	1	4-6	232	1
	MD520N	8.33	8.69	7.62	1.37	2.74	1.98	1.98	*	1 519	1	1	4-6	235	1
	MD900/901	10.31	11.66	9.70	1.63	3.66	2.24	2.24	*	2 631	2	1-2	6-7	553/666	1
MIL	Mi-6 & 22	35.00	41.74	33.18	**	9.86	–	7.50	9.09	42 500	2	5	65/90	3 490	**
	Mi-8	21.29	25.24	8.17	2.50	5.65	–	4.50	4.26	12 000	2	2	24/26	1 870	3
	Mi-17/171	**	25.35	18.42	**	4.76	–	4.51	4.28	13 000	2	2	24/26	**	3
	Mi-34	10.00	**	8.71	1.42	**	2.06	2.06	*	1 350	1	2	2	**	1
Mitsubishi	S-61/ HSS-2	18.90	22.29	16.83	1.98	5.23	3.96	–	7.16	9 297	2	2	26	1 552	2
PZL Swidnik	W-3 Sokol	15.70	18.85	14.21	**	4.12	–	3.40	3.55	6 400	2	2	12	1 700	2
	SW-4	9.00	10.50	8.30	**	**	1.80	1.80	*	1 700	1	**	**	450	1
Robinson	R22	7.67	8.76	6.30	1.12	2.67	1.93	1.93	*	621	1	1	1	72.5	1
	R44	10.06	**	**	**	3.28	2.81	2.81	*	1 088	1	1	1	72.5	1
Sheutzow	Model B	8.25	9.50	7.21	2.13	2.60	2.14	2.14	*	705	1	1	1	83	1

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1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
Siai-Marchetti/ Silvercraft	SH-4	9.03	10.47	7.65	2.32	2.98	1.74	1.74	*	862	1	1	2	110	1
Sikorsky	CH-53D	22.01	26.97	20.47	2.29	7.59	–	3.96	8.23	19 051	3	3	55	2 232	3
	S-55	16.18	19.00	12.85	1.58	4.66	–	3.35	3.20	3 260	1	2	7-10	700	2
	S-55A	16.15	18.98	12.85	1.58	4.65	1.42	3.35	3.20	3 400	1	2	7-10	700	2
	S-56	21.95	25.24	19.80	2.36	6.55	–	6.02	11.25	14 060	2	2	20	1 515	3
	S-58T	17.07	20.06	14.69	1.52	4.85	–	3.66	8.61	5 896	1	2	16	1 070	2
	S-61	18.90	22.14	18.16	1.98	5.13	–	3.96	7.16	8 630	2	2	25	**	2
	S-61L	18.90	22.21	22.12	1.98	5.11	–	3.96	7.17	8 610	2	3	28	1 550	2
	S-61N	18.90	22.25	18.10	1.98	5.64	4.27	–	7.16	9 299	2	3	26-28	1 552	2
	S-61R	18.90	22.25	17.80	1.98	5.55	4.06	–	5.19	10 000	2	3	30	2 559	2
	S-62	16.15	18.97	13.59	1.62	4.88	–	3.35	5.43	3 400	1	2	12	**	2
	S-62A	16.15	19.00	13.58	1.62	4.87	–	3.66	5.49	3 400	1	1-2	10	709	2
	S-62C	16.15	18.97	13.59	1.62	4.87	3.68	–	5.20	3 760	1	2	10	1 125	2
	S-64E	21.95	26.97	21.39	**	7.74	–	6.02	7.44	19 051	2	2-3	45	3 328	3
	S-64F	22.02	26.97	21.39	**	7.72	–	6.02	7.44	21 319	2	2	3	3 328	3
	S-76	13.41	16.00	13.22	1.93	4.41	–	2.44	5.00	4 672	2	2	12	1 060	2
	S-76B	13.41	16.00	13.43	2.13	4.41	–	2.44	5.00	5 307	2	2	12-13	1 064	2
	HH-3E	11.90	22.25	17.45	1.98	5.51	–	4.06	5.21	10 002	2	2	25-30	**	2
	UH-60A	16.36	19.76	15.26	2.36	5.13	2.70	–	8.83	9 185	2	2-3	11	**	2
Vertol	YHC-1B	17.98	29.72	15.24	3.79	5.59	–	3.15	6.40	14 970	2	**	**	**	3
Westland	Wasp	10.14	12.29	9.29	1.55	2.94	2.64	2.64	2.77	2 490	1	1	4-5	719	1
	Wessex 31	17.07	20.06	15.29	1.68	4.85	3.66	–	8.58	6 120	1	2	10	1 364	2
	Whirlwind 1/2	16.15	18.90	12.90	1.82	4.77	1.42	3.43	3.84	3 630	1	2	8	660	2
	Whirlwind 3	16.15	18.90	13.46	1.82	4.77	1.42	3.43	3.84	3 630	1	2	8	814	2

** No information
* Skids
# Pontoons
– Not applicable

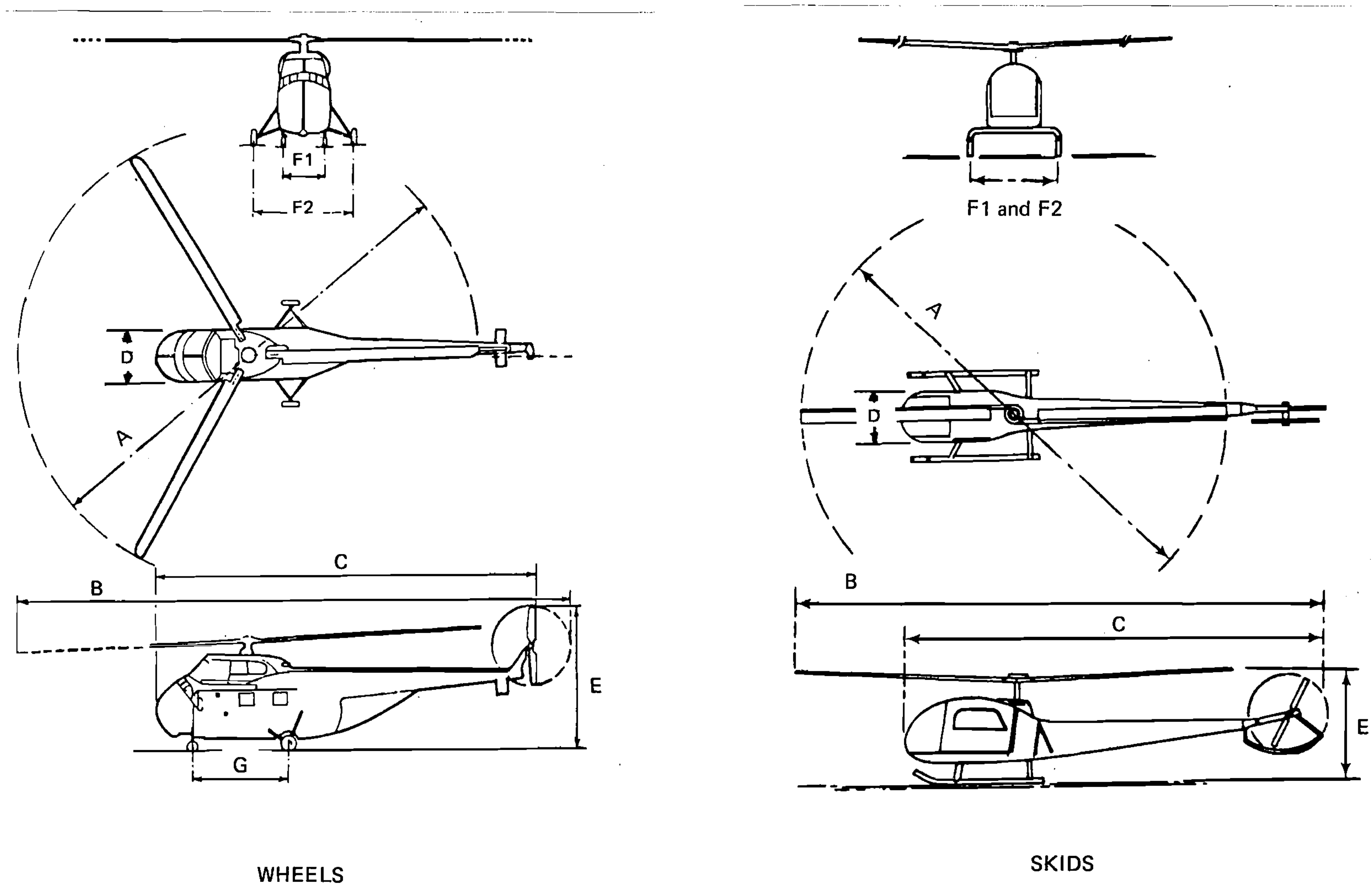

Figure A1-1. Helicopter dimensions — single rotor

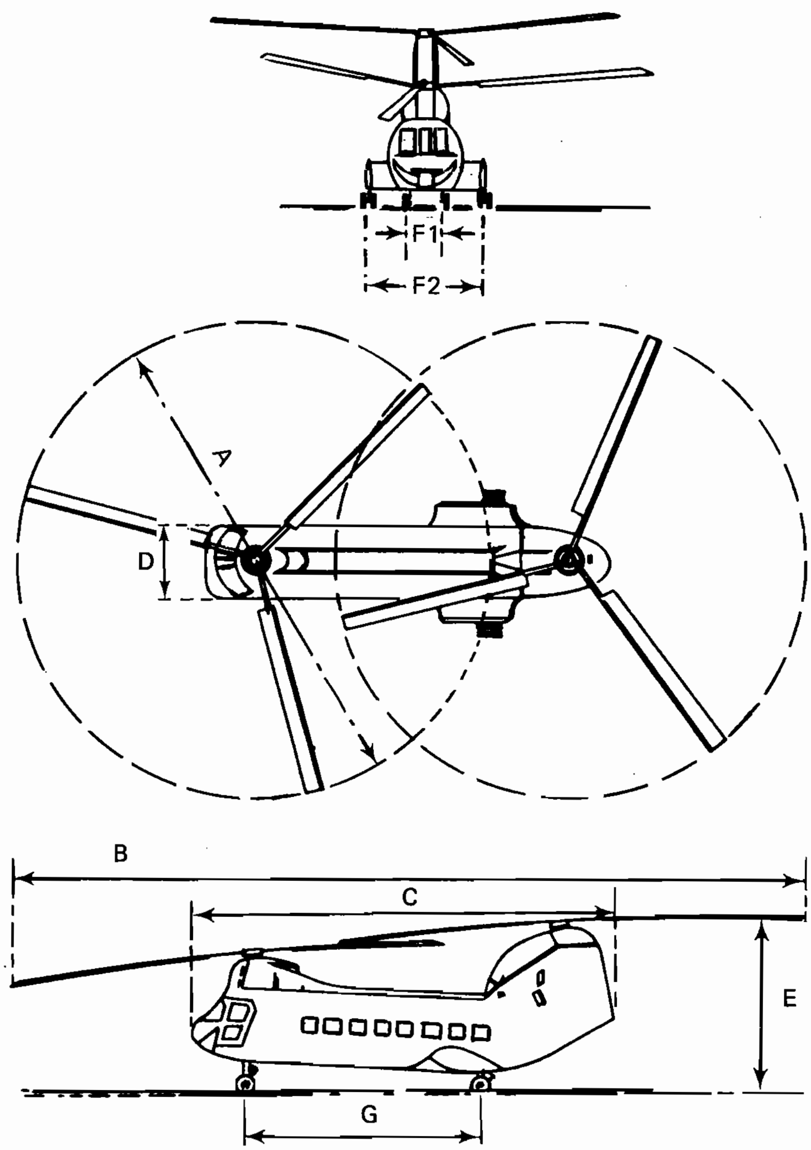

Figure A1-2. Helicopter dimensions — multi-rotor

Appendix 2

GLOSSARY OF TERMS

The following terms with the associated definitions are used throughout this manual:

Aerodrome. An area on the ground or water designed primarily for the use of aeroplanes.

Air taxiway. A defined path on the surface established to permit the movement of helicopters above it while remaining in ground effect at ground speeds not exceeding 37 km/h (20 kt).

Air transit route. A defined path on the surface established to permit the movement of helicopters above it, normally at heights not above 30 m (100 ft) above ground level and at ground speeds in excess of 37 km/h (20kt).

Approach surface. An inclined plane or a combination of planes sloping upwards from the end of the safety area, centred on a line passing through the centre and through which no obstacle may penetrate.

Conical surface. A surface sloping upwards and outwards from the periphery of the inner horizontal surface or outer limit of the transitional surface if an inner horizontal surface is not provided.

Elevated heliport. An area on a raised structure on land designated for the arrival and departure of helicopters.

Final approach and take-off area (FATO). A 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 and, where the FATO is to be used by performance class 1 helicopters, includes the rejected take-off area available.

Ground effect. The reaction to the downward airflow through the helicopter rotor striking the ground or water, which enhances the lift forces acting on the helicopter.

Ground taxiway. A defined path on the surface established to permit the movement over the ground of wheeled helicopters under their own power.

Helicopter clearway. A defined area on the surface beyond the RTODA and under the control of the appropriate authority, selected and/or prepared as a suitable area over which a performance class 1 helicopter may accelerate and achieve a specific height and in which lightweight and frangible objects only are permitted.

Helideck. An area located on a floating or fixed structure offshore designated for use by helicopters.

Heliport. An aerodrome or a defined area on a structure intended to be used wholly or in part for the arrival, departure and surface movement of helicopters.

Heliport elevation. The elevation of the highest point of the landing area.

Heliport reference point. The designated geographical location of a heliport.

Inner horizontal surface. A circular surface located in a horizontal plane above the FATO and its environs and designed to allow safe visual manoeuvring by helicopters.

Landing distance available (LDAH). The length of the FATO plus any additional area declared available and suitable for helicopters to complete the landing manoeuvre from a defined height.

Rejected take-off distance available (TODAH). The length of the FATO declared available and suitable for performance class 1 helicopters to complete a rejected take-off.

Safety area. On a heliport, a defined area surrounding the FATO which is free of obstacles, other than those required for air navigation purposes, and intended to reduce the risk of damage to helicopters accidentally diverging from the FATO.

Take-off climb surface. 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, centred on a line passing through the centre of the FATO and through which no obstacles may penetrate.

Take-off distance available (TODAH). The length of the FATO plus the length of the clearway (if provided) declared available and suitable for helicopters to complete the take-off.

Take-off manoeuvre. The evolution of moving from the hover after lift-off into forward flight, accelerating to climbing speed and achieving a stipulated height.

Take-off space required. The space required after a single engine fails immediately after take-off, for the decision to continue the take-off, accelerate to one-engine-inoperative speed and climb on one engine to a height of 10.7 m (35 ft) above ground or water level.

Touchdown and lift-off area (TLOF). A load bearing area on the FATO or in a separate discrete location on which a helicopter may touch down or lift off.

Transitional surface. A complex surface along the sides of the safety area and parts of the approach surface, that slopes upwards and outwards to the inner horizontal surface or a predetermined height and wherein a helicopter may carry out a safe missed approach.

Water heliport. A heliport on water intended for use by helicopters specifically equipped and approved in relevant Flight Manuals for routine water operations or rejected take-offs on to water.

Winching area. An area intended to be used for helicopter winching operations only.

— END —

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