

PETRONAS TECHNICAL STANDARDS

TECHNICAL SPECIFICATION

HELIDECKS ON FIXED AND MOBILE OFFSHORE INSTALLATIONS

PTS 37.19.10. 31

APRIL 2012



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PTS Updates

This revision of PTS <37.19.10.31> - **Helidecks on Fixed and Mobile Offshore Installations (April 2012, Revision 0)** has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. This specification covers the design of new and assessment of existing fixed steel structures. All updates in the document are highlighted in *italic* font.

The previous version of this **PTS 37.19.10.31 (August 2010, Revision 5)** will be removed from PTS binder / e-repository from herein onwards.

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PREFACE

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**HELIDECKS ON FIXED AND MOBILE
OFFSHORE INSTALLATIONS**

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AMENDMENT SUMMARY

This sheet shall be completed in detail at each revision once this document has been approved.

Details shall include revision number, description and indication of which pages and paragraphs have been revised, date of revision approval, approvers title and signature.

Rev	Description	Date	Approver Title	Signature
0	Original Document	Apr 2012	TA	MSA

Notes:

- (1) Document Holders to update Amendment Record as and when amendments/new revisions are received.
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- (3) Document Holder to enter their company reference number, sign and date the record of entry.
- (4) Where part amendments are issued, the relevant page(s) will be identified with a lower case letter in the revision status line in the header.

Glossary of Terms and Abbreviations

Aerodromes	Also refer as offshore and onshore helidecks/heliports/airports
Aircraft	Also refer as helicopters and fixed wing aeroplanes
Air Operator / Air Service	Any service performed by any aircraft (aviation company) for hire or contract.
AMSL	Above Mean Sea Level.
ANO	Air Navigation Order.
AOC	Air Operator's Certificate.
API	American Petroleum Institute.
ASD	Airport Standard Directives (Malaysia)
ASPSL	Arrays of Segmented Point Source Lighting.
AWOS	Automated Weather Observation System – System that gives real time information and reports on weather conditions (visibility, wind strength, humidity and pressure)
CAR 1996	Malaysian Civil Aviation Regulation 1996
CAP 437	UK Civil Aviation Publication 437, Edition 6 and 7
CFD	Computational Fluid Dynamics.
Class Societies	Organizations that establish and apply technical standards to the design and construction of marine facilities including ships.
D-circle	A circle, usually hypothetical unless the helideck itself is circular, the diameter of which is the D-value of the largest helicopter the helideck is intended to serve.
D-value	The largest overall dimension of the helicopter when rotors are turning. This dimension will normally be measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane (or the most rearward extension of the fuselage in the case of Fenestron or Notar tails). Written at 3 side on the surface of perimeter line of the helideck
DIFFS	Deck Integrated Fire Fighting System(s).
DSV	Diving Support Vessel.
FMS	Fixed Monitor System.

FOD	Foreign Object Debris/Damage.
Falling 5:1 Gradient	A surface extending downwards on a gradient of 5:1 measured from the edge of the safety netting located around the landing area below the elevation of the helideck to water level for an arc of not less than 180° that passes through the centre of the landing area and outwards to a distance that will allow for safe clearance from obstacles below the helideck in the event of an engine failure for the type of helicopter the helideck is intended to serve. For helicopters operated in Performance Class 1 or 2 the horizontal extent of this distance will be compatible with the one-engine inoperative capability of the helicopter type to be used.
FPSO	Floating Production Storage and Offloading units.
FSU	Floating Storage Unit.
HDWG	Heliport Design Working Group.
Helideck	A landing area on an offshore installation or vessel. NOTE: refers to all helicopter landing areas on fixed and mobile installations and vessels unless specifically differentiated. The term 'offshore' is used to differentiate from 'onshore'.
HHOP	Helicopter Hoist Operations Passengers
HLL	Helideck Limitations List
HLO	Helicopter Landing Officer.
HSE	Health, Safety and Environment
IATA	International Air Transport Association.
ICAO	International Civil Aviation Organization.
ICP	Independent and Competent Person
ICS	International Chamber of Shipping.
IMO	International Maritime Organization.
ISO	International Standards Organization.
Landing Area	A generic term referring to the load-bearing area primarily intended for the landing or take-off of aircraft. The area, sometimes referred to as the Final Approach and Take-Off area (FATO), is bounded by the perimeter line and perimeter lighting.

LED	Light Emitting Diode.
LFL	Lower Flammable Limit.
LOS	Limited Obstacle Sector. The 150° sector within which obstacles may be permitted, provided the height of the obstacles is limited.
Mass	Total weight of the aircraft
MEK	Methyl Ethyl Ketone.
MTOM	Maximum Certificated Take-Off Mass.
NAI	Normally Attended Installation.
NM	Nautical Miles
NUI	Normally Unattended Installation.
OFS	Obstacle Free Sector. The 210° sector, extending outwards to a distance that will allow for an unobstructed departure path appropriate to the helicopter the helideck is intended to serve, within which no obstacles above helideck level are permitted. For helicopters operated in Performance Class 1 or 2 the horizontal extent of this distance will be compatible with the one-engine inoperative capability of the helicopter type to be used.
PPE	Personal Protective Equipment.
RD	Rotor Diameter.
RFF	Rescue and Fire Fighting.
Run-Off Area	An extension to the Landing Area designed to accommodate a parked helicopter; sometimes referred to as the Parking Area.
SCBA/EBS	Self-Contained Breathing Apparatus/Emergency Breathing System.
TD/PM Circle	The TD/PM Circle is the aiming point for a normal landing so located that when the pilot's seat is over the marking, the whole of the undercarriage will be within the landing area and all parts of the helicopter will be clear of any obstacles by a safe margin. NOTE: It should be noted that only correct positioning over the TD/PM Circle will ensure proper clearance with respect to physical obstacles and provision of ground effect and provision of adequate passenger access/egress.

t-Value	The helideck maximum weight (in tone) that could withstand the weight of the helicopter, written on the surface of the helideck
UPS	Uninterrupted Power Supply.
Verification Scheme	A suitable written scheme for ensuring the suitability and proper maintenance of safety-critical elements.
WMO	World Meteorological Organization.
Zone 0	An area, where a flammable atmosphere is continuously present or present for long periods of time.
Zone 1	An area where a flammable atmosphere is likely to occur during normal operation.
Zone 2	An area, where a flammable atmosphere is unlikely to occur during normal operations; and if it occurs, will only exist for short period of time.

REFERENCED DOCUMENTS

Doc. No.	Title
AOG	PETRONAS Carigali Aviation Operations Guide (2010)
ASD 103	Department of Civil Aviation Malaysia – Airport Standards Directive 103 – Certification of Aerodrome (2005)
ASD 104	Department of Civil Aviation Malaysia – Airport Standards Directive 104 – Approval and Registration Non-Licensed Aerodrome (2005)
ASD 904	Department of Civil Aviation Malaysia – Airport Standards Directive 904 – Standards for Helidecks (2005)
CAR 1996	Malaysian Civil Aviation Regulation 1996
HSE Management System	PETRONAS Carigali Health, Safety and Environment Management System (Oct 2009)
IATA	International Air Transport Association (IATA) – Dangerous Goods (2004)
ICAO	International Civil Aviation Organization– Annex 14 Volume II – Heliport and Heliport Manual (2009)
JAR 29	Joint Operation Regulation 29 (Europe)
National Aviation Authority	Country's Civil Aviation Department
PCSB WW ALL S 04 003	PCSB Offshore Helideck Operation and Maintenance Guidelines (2011)
UK CAP 437	United Kingdom Civil Aviation Publication 437, 6 th & 7 th Edition 2010 & 2012 – Offshore Helicopter Landing Areas – Guidance on Standards

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CHAPTER 1
INTRODUCTION
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1 PURPOSE

- 1.1 This publication is for PETRONAS offshore industrial standard local and international source of reference on regards to Helidecks on fixed and mobile offshore installations. The contents has been developed, incorporated and adopted base on the Malaysian Airport Standard Directives (ASD)103, 104,904 and Malaysian Civil Aviation Regulation 1996 (CAR 1996), besides the International Civil Aviation Organization (ICAO), Annex 14 Volume II and UK CAP 437, including reviews of the International Standards and Recommended Practices relating to offshore helidecks and shipboard heliports (ISRP).
- 1.2. It defines PETRONAS minimum requirements and technical specification for Helidecks on fixed and mobile offshore installations and associated facilities; to ensure offshore helidecks are complying with industrial and international standard.

2 SCOPE

- 2.1 The requirement defined in this guide shall be applicable for all offshore helidecks throughout PETRONAS local and international operations. This shall include fixed offshore platform, Floating Storage and Offloading Vessel (FSO) / Floating Production, Storage and Offloading Vessel (FPSO), drilling rigs, barges and vessels.
- 2.2 In cases where the requirements of the respective National Aviation Authority of the country are more stringent than the Company standard, the requirement of the National Aviation Authority shall prevail. However, where PETRONAS requirement are more stringent, the Company requirement shall apply.
- 2.3 The primary objective is to ensure the safety of the helicopter and its crew, the passengers, the fixed and mobile offshore installation, and the helideck crew itself.

3 GENERAL REQUIREMENT

- 3.1 This guide has been developed based on assumption that the offshore helideck shall be designed in accordance with PETRONAS Technical Standards requirements and respective National Aviation Authority .
- 3.2 The type of helicopter that could operate on the helideck shall be determined by the maximum size and weight in terms of D-value and t-value for which a helideck is certified or verified with regards to size and strength. Helideck should be designed to accept the largest helicopter type that is anticipated to be used such as Sikorsky S92, Eurocopter EC 225 and Augusta Westland AW 139. Landings shall not be permitted for helicopter whose maximum weight exceeds the limitations, i.e. t-value of the deck.
- 3.3 This PTS gives guidance on the criteria required in assessing the standard of offshore helicopter landing areas for local and world-wide use by helicopters registered in Malaysia and other country. These landing areas may be located on:
- a. Fixed offshore installations;
 - b. Mobile offshore installations;
 - c. Vessels supporting offshore mineral exploitation; or
 - d. Other vessels.

- 3.4 It is a normal practice that the helideck is located and build at or near non-hazardous areas or Zone 2. Therefore, the lighting system requirement should be classified and meets Zone 2 requirement.

4 PRINCIPLE

- 4.1 The introduction of Malaysian ASD in 2005 requires all helidecks in Malaysian waters to comply with the ASD 103 and ASD 904. The directives requires approval before construction and certification, before 'public transport' is permitted to land. The UK CAP 437 and ICAO, Annex 14 Volume II publications are used when the National Authority do not have any helideck regulations and should be use as references.
- 4.2 The operator/owner of the installation has to develop the Helideck Operation Manual and Emergency Response Plan (ERP).The helidecks intended for use by 'public transport' aircraft are to be certified by National Aviation Authority .
- 4.3 The operator/owner of a fixed/ mobile installation is to ensure that every landing area forming part of an installation is large enough and has sufficient clear approach/departure paths to enable any helicopter intended to use the landing area safely, to land and take off in any wind and weather conditions permitting helicopter operations and its design and construction are adequate for its purpose.
- 4.4 All PETRONAS's helidecks shall be designed to accommodate the largest, heaviest helicopter (Sikorsky S92 helicopters). The helidecks may be square, circular and polygonal shape large enough with a circle diameter 'D-Value' – 21 meter and t-value of 12.6tonne.Please refer to Chapter 3 Table 1.
- 4.5 Obstacles shall be readily visible. A paint scheme is required on these obstacles to enhance identification by day, alternate black and white for fixed obstacles, and yellow and black bands for movable objects of not less than 0.30meter (12 ins) wide.
- 4.6 Any crane that may obstruct or reach the helideck area or obstacle free sector shall be made visible with a paint scheme of yellow and black bands, of not less than 0.30meter (12 ins) wide.
- 4.7 PETRONAS responsibility that the helideck at which the helicopter is intended to take-off or land are adequately equipped and sufficient manning to ensure the safety of the helideck and helicopter operations.
- 4.8 The AOC holder is responsible in ensuring the landing areas is safe for the helicopter and passengers. The setting of helideck performance limitations due to vessel motion is the responsibility of the helicopter operator as AOC holder.

CHAPTER 2
HELICOPTER PERFORMANCE CONSIDERATIONS

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1 INTRODUCTION

- 1.1 This Chapter explained the helicopter performance and its requirement for helicopter landing areas on offshore installations and vessels. Its resulted from the need to ensure registered helicopters are afforded sufficient space to be able to operate safely at all times in the varying conditions experienced on offshore operation.
- 1.2 The helicopter's performance requirements and handling techniques are contained in the Air Operator Flight Operations Manual.
- 1.3 Helicopter companies operating for public transport are required to hold an Air Operator's Certificate (AOC) which is neither granted nor allowed to remain in force unless they provide procedures for helicopter crews which safely combine the space and performance requirements mentioned above.

2 SAFETY PHILOSOPHY

- 2.1 Helicopter's performance data is scheduled in the Flight Operations Manual which enables flight crew to accommodate the varying ambient conditions and operate in such a way that the helicopter has sufficient space and sufficient engine performance to approach, land and take off from helidecks in safety.
- 2.2 Additionally, Flight Operations Manuals recognize the remote possibility of a single engine failure in flight and state the flying procedures and performance criteria which are designed to minimize the exposure time of the aircraft and its occupants during the short critical periods during the initial stage of take-off, or final stage of landing.
- 2.3 PETRONAS is currently embarking the Performance Class 1 (Category A) and conform to JAR 29 helicopters for the offshore operations in order to ensure that the exposure period in an engine power loss situation, the serviceable engine has sufficient power to gain speed to fly away for a safe landing performance.

3 FACTORS AFFECTING PERFORMANCE CAPABILITY

On any given day helicopter performance is a function of many factors including the actual all-up mass; ambient temperature; pressure altitude; effective wind speed component; and operating technique. Other factors, concerning the physical and airflow characteristics of the helideck and associated or adjacent structures, will also combine to affect the length of the exposure period. These factors are taken into account in the determination of specific and general limitations which may be imposed in order to ensure adequate performance and to ensure that the exposure period is kept to a minimum. In many circumstances the period will be zero. It should be noted that, following a rare power unit failure, it may be necessary for the helicopter to descend below deck level to gain sufficient speed to safely fly away, or in extremely rare circumstances to land on the water. In certain circumstances, where exposure periods would otherwise be unacceptably long, it will probably be necessary to reduce helicopter mass (and therefore payload) or even to suspend flying operations.

CHAPTER 3

HELICOPTER LANDING AREAS – PHYSICAL CHARACTERISTICS

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1 INTRODUCTION

- 1.1 This Chapter provides criteria on the physical characteristics of helicopter landing areas (helidecks) on offshore installations and vessels. It should be noted that it is required to state for each helicopter landing area the maximum size of helicopter in terms of D-value and the mass for which that area is verified with regard to its size and strength. Where the criteria cannot be met in full for a particular size of helicopter, the agencies responsible should liaise with the National Aviation Authority or helideck owner/operator on any operational restrictions that may be considered necessary in order to compensate for deviations from these criteria. The National Aviation Authority or helideck owner/operator will inform the helicopter operators of any restrictions on the helidecks through the Helideck Limitation List (HLL).
- 1.2 The criteria which follow are based on helicopter size and mass. This data is summarized in Table 1 below.

Table 1 D-Value, 't' Value and other Helicopter Type Criteria

	D-value (metres)	Perimeter 'D' marking	Rotor Diameter (metres)	Max weight (kg)	't' value	Landing net size
Dauphin AS365 N3	13.73	14	11.94	4300	4.3t	Small
EC 155B1	14.30	14	12.60	4850	4.9t	Medium
Sikorsky S76 models	16.00	16	13.40	5307	5.3t	Medium
Agusta Westland AW 139	16.66	17	13.80	6800	6.8t	Medium
Bell 412	17.13	17	14.02	5397	5.4t	Not Required
Bell 212	17.46	17	14.63	5080	5.1t	Not required
Bell 214ST	18.95	19	15.85	7936	8.0t	Medium
Super Puma AS332L2	19.50	20	16.20	9300	9.3t	Medium
EC 225	19.50	20	16.20	11000	11.0t	Medium
Sikorsky S92	20.88	21	17.17	12565	12.6t	Large
Sikorsky S61N	22.20	22	18.90	9298	9.3t	Large
Mi 17/Mi 8	25.40	25	21.30	28660	13.0t	Large

1. Manufacturer derived data has indicated that the Maximum Certificated Take-Off Mass (MTOM) of the S92 may grow to 12,565 kg. It is understood that structural design considerations for new build S92 helidecks will normally be based on the higher take-off mass (12,565 kg). Where structural design is verified by an ICP to be in accordance with the 'growth' take-off mass, duty holders are permitted to display the higher 't' value marking on the helideck, i.e. '12.6t'.

NOTE: Where skid-fitted helicopters are used routinely, landing nets are not recommended.

2 HELIDECK DESIGN CONSIDERATIONS – ENVIRONMENTAL EFFECTS

- 2.1 The safety of helicopter flight operations can be seriously degraded by environmental effects that may be present around installations or vessels and their helidecks. The term "environmental effects" is used here to represent the effects of the installation or vessel and/or its systems and/or processes on the surrounding environment, which result in a degraded local environment in which the helicopter is expected to operate. These environmental effects are typified by structure-induced turbulence, turbulence and thermal effects caused by gas turbine exhausts, thermal effects of flares and diesel exhaust emissions, and unburnt hydrocarbon gas emissions from cold flaring or, more particularly, emergency blow down systems. It is almost inevitable that helidecks installed on the cramped topsides of offshore installations will suffer to

some degree from one or more of these environmental effects, and controls in the form of operational restrictions may be necessary in some cases. Such restrictions can be minimised by careful attention to the design and layout of the installation topsides and, in particular, the location of the helideck.

- 2.1.1 Guidance on the design and placement of offshore helidecks is provided in this document, and includes certain environmental criteria (see paragraph 2.2.1 below). These criteria have been set to define safe operating boundaries for helicopters in the presence of known environmental hazards. Where these criteria cannot be met, a limitation is placed in the HLL. These entries are usually specific to particular combinations of wind speed and direction, and either restrict helicopter mass(payload), or prevent flying altogether in certain conditions.
- 2.1.2 The HLL system is operated by the National Aviation Authority or helideck owner/operator for the benefit of the offshore helicopter operators and should ensure that landings on offshore helidecks are properly controlled when adverse environmental effects are present. On poorly designed helidecks, severe operational restrictions may result, leading to significant commercial penalties for an installation operator or vessel owner. Well designed and 'helicopter friendly' platform topsides and helidecks should result in efficient operations and cost savings for the installation operator.

NOTE: It is important that the National Aviation Authority or helideck owner/operator are always be consulted at the earliest stage of design to enable them to provide guidance and information so that the process for authorizing the use of the helideck can be completed in a timely fashion and in a manner which ensures that maximum helicopter operational flexibility is realized. Information from helideck flow assessment studies should be made available to the National Aviation Authority or helideck owner/operator as early as possible to enable them to identify any potential adverse environmental effects that may impinge on helicopter flight operations and which, if not addressed at the design stage, could lead to operational limitations being imposed to ensure that safety is not compromised.

2.2 Helideck Design Guidance

- 2.2.1 A review of offshore helideck environmental issues concluded that many of the decisions leading to poor helideck operability had been made in the very early stages of design, and recommended that it would be easier for designers to avoid these pitfalls if comprehensive helideck design guidance was made available to run in parallel with National Airport Directives or International Standard, see CAA PAPER 2008/03 dated July 2009 Helideck Design Considerations-Environment Effects
- 2.2.2 A research programme was conducted on material covering environmental effects on offshore helideck operations. The objective of the environmental studies is to help platform designers to create offshore installation topside designs, and helideck locations, that are safe and 'friendly' to helicopter operations by minimizing exposure to environmental effects. It is hoped that, if used from 'day one' of the offshore installation design process when facilities are first being laid out, this manual will prevent or minimize many helideck environmental problems at little or no extra cost to the design or construction of the installation.

2.3 Design Criteria

- 2.3.1 The design criteria given in the following paragraphs represent the current best information available and should be applied to new installations, significant modifications to existing installations, and to combined operations (where a mobile platform or vessel is operating in close proximity to another installation). In the case of multiple platform configurations, the design criteria should be applied to the arrangement as a whole.

NOTE: When considering the volume of airspace to which the following criteria apply, installation designers should consider the airspace up to a height above helideck level which takes into consideration the requirement to accommodate helicopter landing and take-off decision points or committal points. This is deemed to be up to a height above the helideck corresponding to 30 ft plus wheels-to-rotor height plus one rotor diameter.

- 2.3.2 All new build offshore helidecks, modifications to existing topside arrangements which could potentially have an effect on the environmental conditions around an existing helideck, or helidecks where operational experience has highlighted potential airflow problems should be subject to appropriate wind tunnel testing or computational fluid dynamics (CFD) studies to establish the wind environment in which helicopters will be expected to operate. As a general rule, a limit on the standard deviation of the vertical airflow velocity of 1.75 m/s should not be exceeded. The helicopter operator should be informed at the earliest opportunity of any wind conditions for which this criterion is not met. Operational restrictions may be necessary.
- 2.3.3 Unless there are no significant heat sources on the installation or vessel, offshore duty holders should commission a survey of ambient temperature rise based on a Gaussian dispersion model and supported by wind tunnel tests or CFD studies for new build helidecks, significant modifications to existing topside arrangements, or for helidecks where operational experience has highlighted potential thermal problems. When the results of such modelling and/or testing indicate that there may be a rise of air temperature of more than 2°C (averaged over a three second time interval), the helicopter operator should be consulted at the earliest opportunity so that appropriate operational restrictions may be applied.
- 2.3.4 The maximum permissible concentration of hydrocarbon gas within the helicopter operating area is 10% Lower Flammable Limit (LFL). Concentrations above 10% LFL have the potential to cause helicopter engines to surge and/or flame out with the consequent risk to the helicopter and its passengers. It should also be appreciated that, in forming a potential source of ignition for flammable gas, the helicopter can pose a risk to the installation itself. It is considered unlikely that routine 'cold flaring' will present any significant risk, but the operation of emergency blow down systems should be assumed to result in excessive gas concentrations. Installation operators should have in place a management system which ensures that all helicopters in the vicinity of any such releases are immediately advised to stay clear.

NOTE: The installation of 'Status Lights' systems is not considered to be a solution to all potential flight safety issues arising from hydrocarbon gas emissions; these lights are only a visual warning that the helideck is in an unsafe condition for helicopter operations.

- 2.3.5 For 'permanent' multiple platform configurations, usually consisting of two or more bridge-linked fixed platforms in close proximity, where there is a physical separation

of the helideck from the production and process operation, the environmental effects of hazards emanating from the 'remote' production platform should be considered on helideck operations. This is particularly appropriate for the case of hot or cold gas exhausts where there will always be a wind direction that carries any exhaust plumes from a neighbouring platform (bridge-linked module) in the direction of the helideck.

- 2.3.6 For 'temporary' combined operations, where one mobile installation or vessel (e.g. afloat) is operated in close proximity to a fixed installation, the environmental effects of hazards emanating from one installation (or vessel) on the other installation (or vessel) should be fully considered. This 'assessment' should consider the effect of the turbulent wake from one platform impinging on the helideck of the other, and of any hot or cold gas exhausts from one installation or vessel influencing the approach to the other helideck. On occasions there may be more than two installations and/or vessels in a 'temporary combined' arrangement. Where this is the case, the effect of turbulent wake and hot gas exhausts from each installation or vessel on all helideck operations within the combined arrangement should be considered.

NOTE: Section 2.3 is primarily concerned with the issue of environmental effects on the helideck design. In respect of permanent multi-platform configurations and 'temporary' combined operations there are a number of other considerations that may need to be addressed. These include, but may not be limited to, the effect of temporary combined operations on helideck obstacle protection criteria.

3 HELIDECK STRUCTURAL DESIGN

This section details the minimum acceptable criteria for the structural design of steel helidecks on COMPANY offshore installations.

- a. Helideck structures should be designed in accordance with relevant International Standards Organization (ISO) codes for offshore structures and floating installation. The maximum size and mass of helicopter for which the helideck has been designed should be stated in the Installation/Vessel Operations Manual and Verification and/or Classification document.
- b. Optimal operational flexibility may be gained from considering the potential life and usage of the facility along with likely future developments in helicopter design and technology.
- c. Consideration should also be given in the design to other types of loading such as personnel, other traffic, snow and ice, freight, refuelling equipment and rotor downwash etc, as stated International Standards Organization (ISO) codes. It may be assumed that single main rotor helicopters will land on the wheel or wheels of two landing gear or both skids (if fitted). The resulting loads should be distributed between two main undercarriages. Where advantageous, a tyre contact area may be assumed in accordance with the manufacturer's specification. Ultimate limit state methods may be used for the design of the helideck structure, including girders, trusses, pillars, columns, plating and stiffeners. A serviceability limit check should also be performed to confirm that the maximum deflection of the helideck under maximum load is within code limits. This check is intended to reduce the likelihood of the helideck structure being so damaged during an emergency incident as to prevent other helicopters from landing.

NOTES: 1. Consideration should be given to the possibility of accommodating an unserviceable helicopter in a designated parking or run-off area (where provided) adjacent to the helideck to allow a relief helicopter to land. If this contingency is designed into the construction/operating philosophy of the installation, the helicopter operator should be advised of any weight restrictions imposed on the relief helicopter by structural integrity considerations. Where a parking or run-off area is provided it is assumed the structural considerations will at least meet the loads criteria applicable for helicopters at rest (see Section 3.2.1.2).

2. Alternative loading criteria equivalent to those recommended here and in paragraphs 3.2.1.1 and 3.2.1.2 may be used where aircraft-specific loads have been derived by the aircraft manufacturer from a suitable engineering assessment taking account of the full range of potential landing conditions, including failure of a single engine at a critical point, and the behaviour of the aircraft undercarriage and the response of the helideck structure. The aircraft manufacturer should provide information to interested parties, including the owner or operator of the installation, the helicopter operators and HSE to justify any such alternative criteria. The aircraft manufacturer opinion and assume that a single engine failure represents the worst case in terms of rate of descent on to the helideck amongst likely survivable emergencies.

3.1 REFERENCES

3.1.1. Codes and Standards

The latest edition of the following standards, rules and codes shall govern the helideck design. Where the requirements of this specification are in conflict with, or expand the requirements of these documents, this Specification shall prevail.

- a. PTS 37.28.00.30 "Construction of Structural Steelwork"
- b. PTS 30.48.00.31 "Protective Coatings and Lining"
- c. API RP 2A "Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms"
- d. API RP 2T "Recommended Practice for Planning, Designing and Constructing Heliports for Fixed Offshore Platforms"
- e. AISC "Steel Construction Manual"
- f. UK CAP 437 "Offshore Helicopter Landing Areas: Guidance on Standards"
- g. AISC "Design Manual for Orthotropic Steel Plate Deck Bridges"

3.2 HELIDECK DESIGN PARAMETERS

COMPANY offshore installations helideck take-off and landing area should be designed for Sikorsky S92A1 helicopter with a D=21m, and maximum weight t=12.6tonne. Smaller helideck may be used if approved by the COMPANY.

3.2.1 LOADS

3.2.1.1 HELICOPTERS LANDING

The helideck primary support beams and columns, plating, plating stiffeners and secondary beams should be designed to withstand all the forces likely to act when a helicopter lands. The loads and load combinations to be considered should include:

a. Dynamic load due to impact landing

This should cover both a heavy normal landing and an emergency landing. For heavy normal landing, an impact load of $1.5 \times \text{MTOM}$ of the helicopter should be used, distributed as described in paragraph 3.c above. This should be treated as an imposed load, applied together with the combined effect of 3.2.1.1b) to f) below in any position on the landing area so as to produce the most severe load on each structural element. For this load case, stresses in the plating, plating stiffeners and secondary beams may reach yield, i.e. 100% of their elastic capacity may be developed while the primary support beams and columns shall be designed to normal allowable stress criteria plus one third increase.

For an emergency landing, an impact load of $2.5 \times \text{MTOM}$ should be applied in any position on the landing area together with the combined effects of 3.2.1.1b) to f) inclusive. At such high impact values one can expect a helicopter undercarriage to be at the point of failure. After failure, the loading changes from discrete concentrated loads to a less severe uniformly distributed load. The governing consideration here therefore is that the decking system should not be ruptured, allowing fuel, possibly burning fuel, onto other areas. It is recommended that the plating, plating stiffeners and secondary beams be allowed to develop 90% of their ultimate plastic capacity. Local damage in the form of dishing is considered acceptable under such a severe load.

Normally, the emergency landing case will govern the design of the structure.

b. Sympathetic response of landing platform

After considering the design of the helideck structure's supporting beams and columns and the characteristics of the designated helicopter, the dynamic load (see 3.2.1.1 a) above) should be increased by a suitable structural response factor depending upon the natural frequency of the helideck structure. It is recommended that a structural response factor of 1.3 should be used unless further information allows a lower factor to be calculated. Information required to do this will include the natural periods of vibration of the helideck and the dynamic characteristics of the designated helicopter and its landing gear. For this load case the primary support beams and columns may develop 100% of their elastic capacity.

c. Overall superimposed load on the landing platform

To allow for any appendages that may be present on the deck surface e.g. helideck net, "H" and circle lighting, in addition to wheel loads, an allowance of 0.5 kiloNewtons per square metre (kN/m^2) should be added over the whole area of the helideck.

d. Lateral load on landing platform supports

The landing platform and its supports should be designed to resist concentrated horizontal imposed loads equivalent to $0.5 \times \text{MTOM}$ of the helicopter, distributed between the undercarriages in proportion to the applied vertical loading in the direction which will produce the most severe loading on the element being considered.

e. **Dead load of structural members.**

This is the normal gravity load on the element being considered.

f. **Wind loading**

Wind loading should be allowed for in the design of the platform. The 100-year return period wind action should be applied in the direction which, together with the imposed lateral loading, will produce the most severe loading condition on each structural element.

g. **Punching shear**

A check should be made for the punching shear from a wheel of the landing gear with a contact area of 65 x 103 mm² acting in any probable location. Particular attention to detailing should be taken at the junction of the supports and the platform deck.

3.2.1.2 HELICOPTERS AT REST

The helideck should be designed to withstand all the applied forces that could result from a helicopter at rest; The following loads should be taken into account:

a. **Imposed load from helicopter at rest**

All areas of the helideck accessible to a helicopter, including any separate parking or run-off area, should be designed to resist an imposed load equal to the MTOM of the helicopter. This load should be distributed between all the landing gear. It should be applied in any position on the helideck so as to produce the most severe loading on each element considered.

b. **Overall superimposed load**

To allow for personnel, freight, refuelling equipment and other traffic, snow and ice, rotor downwash etc, an allowance of 0.5 kiloNewtons per square metre (kN/m²) should be added to the whole area of the helideck.

c. **Dead load and wind load**

The values for these loads are the same as given in paragraph 3.2.1.1e and f above and should be considered to act simultaneously in combination with 3.2.1.2a and b above. Consideration should also be given to the additional wind loading from any parked or secured helicopter.

d. **Acceleration forces and other dynamic amplification forces**

The effect of these forces, arising from the predicted motions of mobile installations and vessels, in the appropriate environmental conditions (corresponding to a 10-year return period), should be considered.

3.2.2 MODIFIED AISC/API ALLOWABLE STRESSES FOR DIFFERENT LANDING CONDITIONS

The allowable stresses for the primary support beams and columns and plating, plating stiffeners and secondary beams for the different landing conditions described in Section 3.2.1.1 and 3.2.1.2 above are tabulated in Table 2 below.

Table 2 Chart of Modified AISC/API Allowable Stresses for different landing conditions

Loading Location	Helicopter at rest (Static)	Heavy Landing (1.5g)	Emergency Landing	
			2.5g	2.5g x SRF
Loads on plating, plating stiffeners and secondary beams	Normal	100% F_y	90% Ultimate	-
Loads on primary support beams and columns	Normal	1.33 x Normal	-	100% F_y

3.2.3 DESIGNS OF SURFACE PLATING

3.2.3.1 Impact Factors - Elastic and Plastic Design

Generally structural steel designers deal with stress levels below the elastic limit of the material. However, flat plate subject to discrete out-of plane loading has a high strength reserve if stress levels are kept below yield. If stress levels are allowed to yield then plating can be made to work efficiently. How this can be achieved is described in detail below.

Helidecks are designed to carry high impact loads associated with heavy landings. Heavy landings are a rare occurrence and helidecks are normally subject to controlled landings where the static load of the helicopter is gradually realized.

By studying the behavior of helicopter landings and the strength of helicopters in general, impact factors have been derived which will result in structurally efficient helidecks. With any chosen impact factor it is possible to specify an allowable stress. For example a helicopter's undercarriage is generally only capable of imposing a load of 2.5 x the helicopter's weight. Thus, this must be seen as the maximum point load. Under the above loading the helicopter will be severely damaged. It is reasonable under such a load to allow local deformation of secondary structural elements, the repair of which, if deemed necessary, could be carried out easily. Secondary structural elements are those which, if damaged, would not affect overall integrity and which are easily repaired. It is suggested that the following elements are considered as secondary:

- plating,
- plating stiffeners,
- horizontal beams not part of any main longitudinal or transverse truss.

An impact factor of 1.5 is realistic when considering the elastic response of the structure. Even so, a 1.5 impact factor implies a load 50% greater than that normally

incurred. For this reason, secondary structural elements are allowed to develop 100% of their elastic capacity. This involves a safety factor against plastic deformation which relates to the 'shape factor' associated with the section being considered. Elastic capacity may be considered as the capacity when stresses are allowed to reach yield, no account is taken of any plastic resistance. Due consideration must be given to stress interaction. Plastic capacity may be considered as the capacity of the fully developed mechanism that will be formed by any ductile material.

3.2.3.2 Plating Design

There are theoretical solutions that predict maximum elastic stresses in flat plates subject to concentrated lateral loads. Such solutions do not model the edge conditions that are found in practice. Amongst others, Det Norske Veritas has carried out research into the question of allowable wheel loads on deck plating. The DnV Rules for the Classification of Steel Ships contain a method for calculating the plate thickness required to carry wheel loads on flat plates. It is recommended that this method be used. The reference is: Part 5, Chapter 2, and Section 4C.

3.2.3.3 Normal Allowable Stresses

Normal allowable stresses are those stress levels which are allowable when ordinary loads are considered to act on the structural element, i.e. no 1/3 increase is allowable if design is being carried out to AISC Specification.

3.3 REASSESSMENT OF EXISTING HELIDECK

3.3.1 Assessment Initiators

- a. Higher helicopter weight
- b. Damage of helideck structural member due to:
 - i. Degradation (metal loss etc)
 - ii. Accidental Event (dented, fire etc)

3.3.2 Reassessment Procedure

Adopt normal design process according to Section 3.0 by considering the as-is condition of helideck.

In cases not meeting the design criteria:

- a. The helicopter manufacturer to undertake following requirements:
 - i. Testing to simulate the emergency situation
 - ii. Assessment to derive required factor to be adopted on the loading requirement
 - iii. Obtain acceptance from National Aviation Authority
- b. Detailed / refined analysis should be carried out by adopting new load factor derived based on specific study.

4. HELIDECK LIFTS

Where appropriate, a lifting analysis of the helideck should be performed and the padeyes incorporated in the drawings. Access platforms to these padeyes, accessible by removable hatches, shall be provided to reduce rigging time of shackles.

5. SURFACE AND DRAINAGE

The landing area shall be painted in accordance with PTS 30.48.00.31-P "Protective Coatings and Lining", with markings as specified in Chapter 4, Visual Aids.

To ensure adequate drainage on fixed installations, the landing area should be laid to a fall or cambered to prevent rainwater and fuel spills from remaining on the deck. A minimum gradient of 1:100 towards the sea is required. The deflection of the deck surface due to loads from a helicopter at rest should not modify the landing area drainage system to the extent of allowing, spilled fuel to remain on the deck. A system of guttering should be provided around the perimeter to prevent spilled fuel from falling onto the other parts of the installation and to conduct the spillage to sea level.

6. SIZE AND OBSTACLE PROTECTED SURFACES

NOTE: The location of a specific helideck is often a compromise given the competing requirements for space. Helidecks should be at or above the highest point of the main structure. This is a desirable feature but it should be appreciated that if this entails a landing area much in excess of 60 m above sea level, the regularity of helicopter operations may be adversely affected in low cloud base conditions.

- 6.1 For any particular type of single main rotor helicopter, the helideck should be sufficiently large to contain a circle of diameter D equal to the largest dimension of the helicopter when the rotors are turning. This D-circle should be totally unobstructed (see Table 1 for D values). Due to the actual shape of most offshore helidecks the D-circle will be 'hypothetical' but the helideck shape should be capable of accommodating such a circle within its physical boundaries.
- 6.2 From any point on the periphery of the above mentioned D-circle an obstacle-free approach and take-off sector should be provided which totally encompasses the landing area (and D-circle) and which extends over a sector of at least 210°. Within this sector obstacle accountability should be considered out to a distance from the periphery of the landing area that will allow for an unobstructed departure path appropriate to the helicopter the helideck is intended to serve. For helicopters operated in Performance Class 1 the horizontal extent of this distance from the helideck will be based upon the one-engine inoperative capability of the helicopter type to be used. In consideration of the above, only the following items may exceed the height of the landing area, but shall not be more than 25 centimetres:
 - a. The guttering (associated with the requirements in paragraph 7.2);
 - b. The lighting required by Chapter 4;
 - c. The foam monitors (where provided); and

- d. Those handrails and other items (e.g. EXIT sign) associated with the landing area which are incapable of complete retraction or lowering for helicopter operations.
- 6.3 Objects whose function requires that they be located on the surface of the landing area such as landing nets and, in future, “stage 2” lighting systems (see Chapter 4, paragraph 3.4) should not exceed the surface of the landing area by more than 2.5 cm. Such objects should only be present provided they do not cause a hazard to helicopter operations.
- 6.4 The bisector of the 210° obstacle free sector (OFS) should normally pass through the centre of the D-circle. The sector may be ‘swung’ by up to 15° as illustrated in Figure 1. Acceptance of the ‘swung’ criteria will normally only be applicable to existing installations.

NOTE: If the 210° obstacle free sector is swung, then it would be normal practice to swing the 180° falling 5:1 gradient by a corresponding amount to indicate, and align with, the swung OFS.

- 6.5 The diagram at Figure 1 shows the extent of the two segments of the 150° Limited Obstacle Sector (LOS) and how these are measured from the centre of the (hypothetical) D-circle and from the perimeter of the landing area. This diagram assumes, since most helidecks are designed to the minimum requirement of accommodating a 1 D-circle, that the D-circle perimeter and landing area perimeter are coincidental. No objects above 25 cm are permitted in the first (hatched area in Figure 1) segment of the LOS. The first segment extends out to 0.62D from the centre of the D-circle, or 0.12D from the landing area perimeter marking. The second segment of the LOS, in which no obstacles are permitted to penetrate, is a rising 1:2 slope originating at a height of 0.05D above the helideck surface and extending out to 0.83D from the centre of the D-circle (i.e. a further 0.21D from the edge of the first segment of the LOS).

NOTE: The exact point of origin of the LOS is assumed to be at the periphery of the D-circle.

- 6.6 Some helidecks are able to accommodate a landing area which covers a larger area than the declared D-value; a simple example being a rectangular deck with the minor dimension able to contain the D-circle. In such cases it is important to ensure that the origin of the LOS (and OFS) is at the perimeter of the landing area as marked by the perimeter line. Any landing area perimeter should guarantee the obstacle protection afforded by both segments of the LOS. The respective measurements of 0.12D from the landing area perimeter line plus a further 0.21D are to be applied. On these larger decks there is thus some flexibility in deciding the position of the perimeter line and landing area in order to meet the LOS requirements and when considering the position and height of fixed obstacles. Separating the origin of the LOS from the perimeter of the D-circle in Figure 1 and moving it to the right of the page will demonstrate how this might apply on a rectangular-shaped landing area.

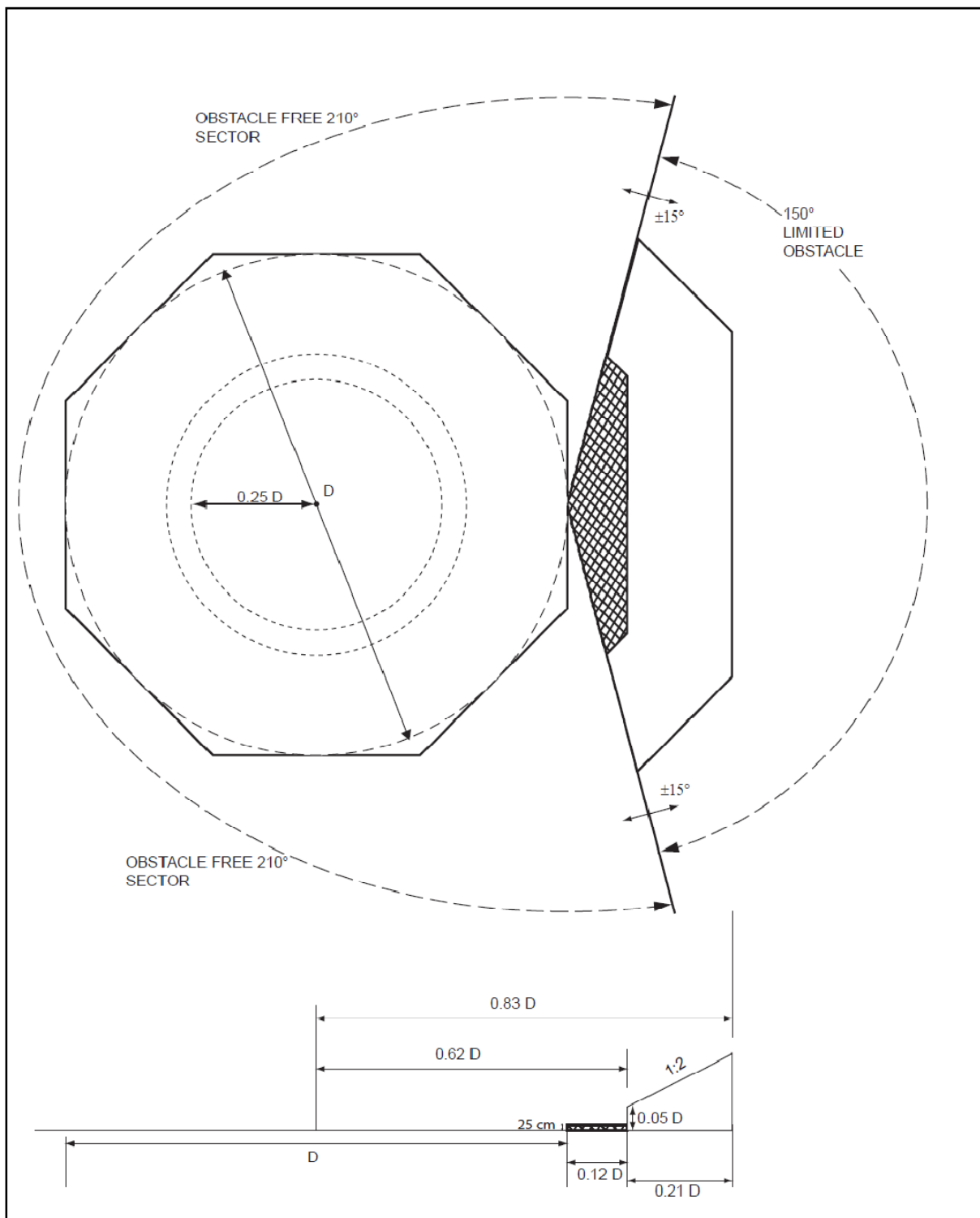


Figure 1 Obstacle Limitation (Single Main Rotor and Side by Side Main Rotor Helicopters) showing position of Touchdown/Positioning Marking circle

NOTE: Where the D-value is 16.00m or less objects in the first segment of the LOS are restricted to 5 cm.

- 6.7 The extent of the LOS segments will, in all cases, be lines parallel to the landing area perimeter line and follow the boundaries of the landing area perimeter (see Figure 1). Only in cases where the perimeter of the landing area is circular will the extent be in the form of arcs to the D-circle. However, taking the example of an octagonal landing area as drawn at Figure 1, it would be possible to replace the angled corners of the two LOS segments with arcs of $0.12D$ and $0.33D$ centred on the two adjacent corners of the landing area, thus cutting off the angled corners of the LOS segments. If these arcs are applied they should not extend beyond the two corners of each LOS segment so that minimum clearances of $0.12D$ and $0.33D$ from the corners of the landing area are maintained. Similar geometric construction may be made to a square or rectangular landing area but care should be taken to ensure that the LOS protected surfaces minima can be satisfied from all points on the inboard perimeter of the landing area.
- 6.8 Whilst application of the criteria in paragraph 6.2 above will ensure that no unacceptable obstructions exist above the helicopter landing area level over the whole 210° sector, it is necessary to consider the possibility of helicopter loss of height due to a power unit failure during the latter stages of the approach or early stages of take-off. Accordingly, a clear zone should be provided below landing area level on all fixed and mobile installations between the helideck and the sea. The falling 5:1 gradient should be at least 180° with an origin at the centre of the D-circle and ideally it should cover the whole of the 210° OFS. It should extend outwards for a distance that will allow for safe clearance from obstacles below the helideck in the event of an engine failure for the type of helicopter the helideck is intended to serve. (See also Glossary of Terms and Abbreviations.) For helicopters operated in Performance Class 1 the horizontal extent of this distance from the helideck will be based upon the one-engine inoperative capability of the helicopter type to be used (see Figure 2). All objects that are underneath anticipated final approach and take-off paths should be assessed.
- NOTES:** 1. For practical purposes the falling obstacle limitation surface can be assumed to be defined from points on the outboard edge of the helideck perimeter safety netting supports (1.5 metres from deck edge). Minor infringements of the surface by foam monitor platforms or access/escape routes may be accepted only if they are essential to the safe operation of the helideck but may also attract helicopter operational limitations.
2. Following a single engine failure in a twin engine helicopter after take-off decision point, and assuming avoidance of the deck edge, the resulting trajectory will carry the helicopter clear of any obstruction in the range 2:1 to 3:1. It is therefore only necessary for operators to account for performance in relation to specified 5:1 falling gradient when infringements occur to a falling 3:1 rather than a 5:1 slope.
- 6.9 It is recognized that when support installations, such as 'flotels' and crane-barges, are operating close to other installations, it will not always be possible to meet the horizontal and vertical obstacle protected surface requirements. In these circumstances, installation operators should attempt to meet the above criteria as closely as possible when planning the siting of a combination of installations or an installation and a vessel, and should forward the drawings of the proposed configuration to the National Aviation Authority or an authorized helideck agency as early as possible in the process for assessment and consultation on the operational aspects. Consultation with the owner and air operator in the early planning stages will help to optimize helicopter operations for support installation location.

NOTE: As a general rule, on helidecks where obstacle-protected surfaces are infringed by other installations or vessels positioned within a horizontal distance from the helideck which is based upon the airspace requirements needed to accommodate the one-engine inoperative capability of the helicopter type to be used, it may be necessary to impose helicopter operating restrictions on one or all of the helidecks affected.

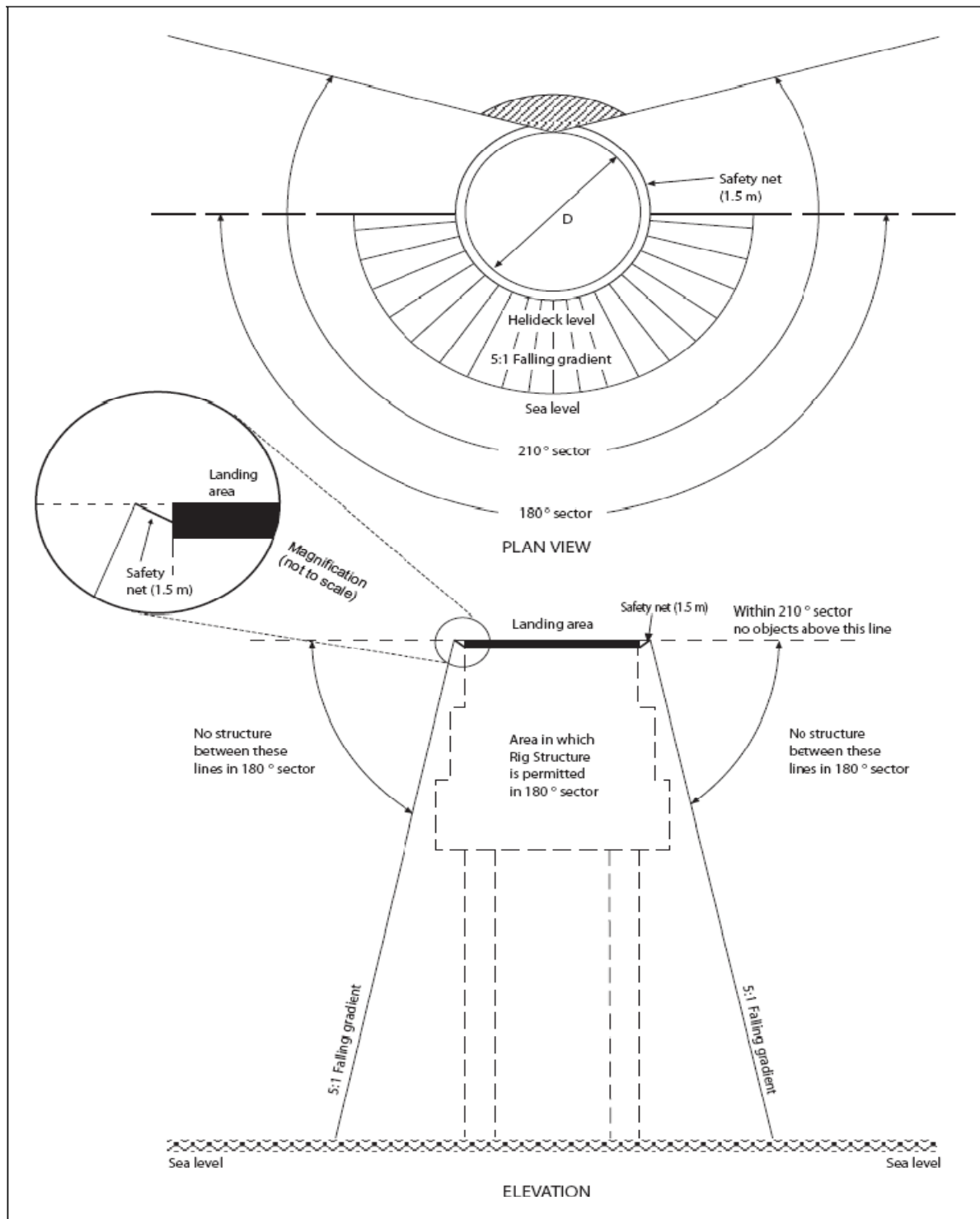


Figure 2 Obstacle Free Areas – Below Landing Area Level (for all types of helicopters)

- 6.10 It is accepted that, at times, short-term infringement to obstacle-protected surfaces cannot be avoided when, for example, supply/support vessels work close to an installation. It may be impractical to assess such situations within the time available. However, the helicopter operator may need to apply operational limitations in such circumstances. It is therefore important for helicopter crews to be kept informed of all temporary infringements.

7 SURFACE

NOTE: Where a helideck is constructed in the form of a grating, e.g. where a passive fire retarding system is selected (see Chapter 5), the design of the helideck should ensure that ground effect is not reduced.

- 7.1 The landing area should have an overall coating of non-slip material and all markings on the surface of the landing area should be finished with the same non-slip materials. Whilst extruded section or grid construction aluminium (or other) decks may provide adequate resistance to sliding, they should be coated with a non-slip material unless adequate friction properties have been confirmed by measurement (see paragraph 7.5). It is important that adequate friction exists in all directions. Over-painting friction surfaces on such designs with other than non-slip material will likely compromise the surface friction. Suitable surface friction material is available commercially.
- 7.2 Every landing area should be equipped with adequate surface drainage arrangements and a free-flowing collection system that will quickly and safely direct any rainwater and/or fuel spillage and/or fire fighting media away from the helideck surface to a safeplace. Helidecks on fixed installations should be cambered (or laid to a fall) to approximately 1:100. Any distortion of the helideck surface on an installation due to, for example, loads from a helicopter at rest should not modify the landing area drainage system to the extent of allowing spilled fuel to remain on the deck. A system of guttering on a new build or a slightly raised kerb should be provided around the perimeter to prevent spilled fuel from falling on to other parts of the installation and to conduct the spillage to an appropriate drainage system. The capacity of the drainage system should be sufficient to contain the maximum likely spillage of fuel on the helideck. The calculation of the amount of spillage to be contained should be based on an analysis of helicopter type, fuel capacity, typical fuel loads and uplifts. The design of the drainage system should preclude blockage by debris. The helideck area should be properly sealed so that spillage will only route into the drainage system.
- 7.3 Tautly-stretched rope netting should be provided to aid the landing of helicopters with wheeled undercarriages in adverse weather conditions. The intersections should be knotted or otherwise secured to prevent distortion of the mesh. It is preferable that the rope be constructed of sisal, with a maximum mesh size of 200 mm. The rope should be secured every 1.5 metres round the landing area perimeter and tensioned to at least 2225 N. The netting made of material other than sisal may be considered but netting should not be constructed of polypropylene-type material which is known to rapidly deteriorate and flake when exposed to weather. Tensioning to a specific value may be impractical offshore. As a rule of thumb, it should not be possible to raise any part of the net by more than approximately 250 mm above the helideck surface when applying a vigorous vertical pull by hand. The location of the net should ensure coverage of the area of the Touchdown/Positioning Marking but should not

cover the helideck identification marking or 't' value markings. Some nets may require modification to corners so as to keep the identification markings uncovered. In such circumstances the dimensions given in Table 3 may be modified.

NOTE: It should be borne in mind when selecting an appropriate helideck netting solution that the height of the netting (i.e. the thickness of the installed net including knots) should accord with the requirements specified in Section 6.4.

- 7.4 There are three sizes of netting as listed below in Table 3. The minimum size depends upon the type of helicopter for which the landing area is to be used as indicated in Table 1

Table 3 Helicopter Deck Netting

Small	9 metres by 9 metres
Medium	12 metres by 12 metres
Large	15 metres by 15 metres

NOTE: Some helideck nets may be circular rather than square.

- 7.5 For fixed Manned Installations, where no significant movement due to environmental conditions occurs, provided the helideck can be shown to achieve an average surface friction value of not less than 0.65 determined by a test method acceptable to National Aviation Authority, the helideck landing net may be removed. The installation operator should ensure thereafter that the helideck is kept free from oil, grease, ice, snow, excessive surface water or any other contaminant (particularly guano) that could degrade surface friction. Assurance should be provided to the helicopter operator that procedures are in place for elimination and removal of contaminants prior to helicopter movements. Following removal of the netting, the helideck should be re-tested at regular intervals. The criteria for initial removal and the frequency of subsequent testing should be approved by a National Aviation Authority or helideck inspector. Friction testing periodicity can be determined using a simple trend analysis as described in this paper. Table 4 indicates typical frequencies of inspection for given ranges of friction values.
- 7.6 Consideration to remove landing nets on Unmanned Installations may only be given if procedures are in place which guarantee that the helideck will remain clear of contaminants such that there is no risk of helideck markings and visual cues being compromised or friction properties reduced.
- 7.7 Landing nets on mobile installations have generally, in the absence of any research, been regarded as essential. However, it may be possible to present a safety case to the National Aviation Authority for specific installations.

Table 4 Friction Requirements for Landing Area Net Removal

Average surface friction value	Maximum period between test
0.85 and above (Recognized Friction Surface) ¹	36 months
0.7 to 0.84	12 months
0.65 to 0.69	6 months
Less than 0.65 ¹	Net to be retained

- 7.8 Experience has shown that the removal of landing nets on some installations has resulted in undesirable side-effects. Although the purpose of the landing net is to help prevent the helicopter sliding on the helideck, it does also provide a degree of visual cueing to pilots in terms of rate of closure and lateral movement. Such visual cueing is essential for safe control of the helicopter and, on some installations, removal of the landing net could significantly degrade the cueing environment. Serious consideration should be given to this aspect before a landing net is removed. The helicopter operator should be consulted before existing landing nets are removed and installation operators should be prepared to re-fit landing nets if so advised by the helicopter operator in the case that visual cueing difficulties are experienced. For these reasons it is also recommended that the design of new installations should incorporate the provision of landing net fittings regardless of the type of friction surface to be provided.

8 HELICOPTER TIE-DOWN POINTS

- 8.1 Sufficient flush fitting (when not in use) tie-down points should be provided for securing the maximum sized helicopter for which the helideck is designed. They should be so located and be of such strength and construction to secure the helicopter when subjected to weather conditions pertinent to the installation design considerations. They should also take into account, where significant, the inertial forces resulting from the movement of floating units.
- 8.2 Tie-down points should be compatible with the dimensions of tie-down strop attachments. Tie-down points and strops should be of such strength and construction so as to secure the helicopter when subjected to weather conditions pertinent to the installation design considerations. The maximum bar diameter of the tie-down point should be 22 mm in order to match the strop hook dimension of the tie-down strops carried in offshore helicopters. Advice on recommended safe working load requirements for strop/ring arrangements for specific helicopter types can be obtained from the helicopter operator.
- 8.3 An example of a suitable tie-down configuration is shown at Figure 3. The National Aviation Authority will provide guidance on the configuration of the tie-down points for specific helicopter types.

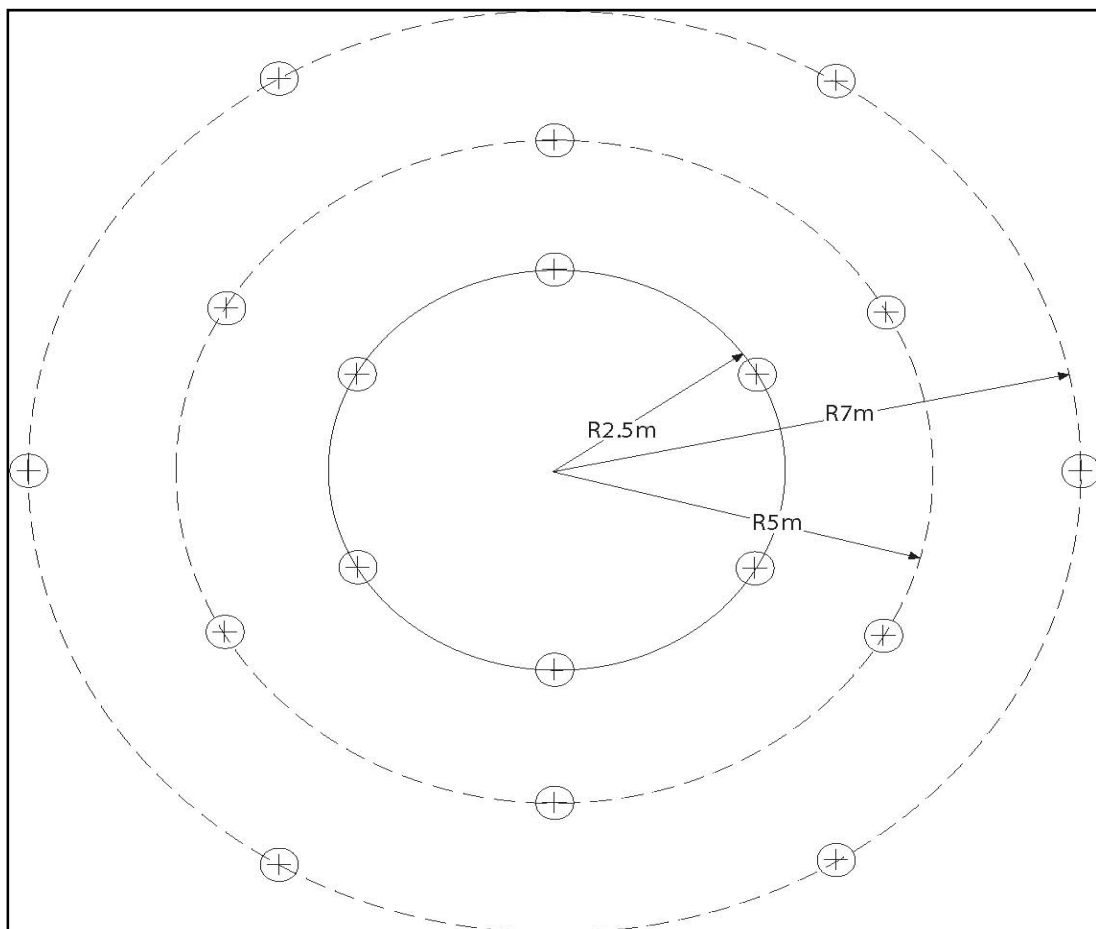


Figure 3 Example of Suitable Tie-down Configuration

NOTES:

1. The tie-down configuration should be based on the centre of the TD/PM circle.
2. Additional tie-downs will be required in a parking area.
3. The outer circle is not required for D-values of less than 22.2 m.

9 PERIMETER SAFETY NET

- 9.1 Perimeter safety nets for personnel protection should be installed around the landing area except where adequate structural protection against a fall exists. The netting used should be of a flexible nature, with the inboard edge fastened just below the edge of the helicopter landing deck. The net itself should extend 1.5 metres in the horizontal plane and be arranged so that the outboard edge does not exceed the level of the landing area and angled so that it has an upward and outward slope of approximately 10°.
- 9.2 The perimeter safety net designed to meet these criteria should 'contain' personnel falling into it and not act as a trampoline. Where lateral or longitudinal centre bars are provided to strengthen the net structure they should be arranged and constructed to avoid causing serious injury to persons falling on to them. The ideal design should produce a 'hammock' effect which should securely contain a body falling, rolling or jumping into it, without serious injury. When considering the securing of the net to the structure and the materials used, care should be taken that each segment will be fit