

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

MANUAL (SM)

PRACTICE FOR THE DESIGN OF HELIDECKS ON FIXED OR MOBILE OFFSHORE INSTALLATIONS

PTS 37.19.10.43

APRIL 2011



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This revision of PTS **37.19.10.43 – Practice For The Design Of Helidecks On Fixed Or Mobile Offshore Installations (April 2011, Revision 1)** has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. It is the updated version of PTS **20.053**.

The previous version of PTS **20.053 (December 1989)** will be removed from PTS binder / e-repository from herein onwards.

Document Approval

	Name	Designation	Date	Signature
Prepared/ Reviewed	Zulhilmi B Lihin	Senior Structural Engineer, CSP, Engineering, GTS	08/04/11	
	Lai Tze Khai	Structural Engineer, CSP, Engineering, GTS	08/04/11	
Approved	M Sapihie B Ayob	Principal Structural Engineer, CSP, Engineering, GTS	08/04/11	
Verified	Hashim B Zainal Abidin	Senior Manager, CSP, Engineering, GTS	08/04/11	
Verified	V R Harindran	for General Manager, Engineering, GTS	9/4/11	
Endorsed	Pau Kiew Huai	Senior General Manager, GTS	12.5.11	

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PREFACE

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PREFACE TO ORIGINAL REPORT, APRIL 1981

The need has arisen to consolidate the Group's, and the industry's experience in helideck design. The various worldwide regulatory bodies and the various personnel in charge of helicopter operations have been working to more clearly define a helideck's service requirements. This has led to different worldwide standards, even for helidecks subject to similar operations. Progress has been made, for instance, in defining loads and in analysis techniques, resulting in safer and more economic helidecks. This document consolidates the experience and knowledge gained to date and will unify PETRONAS Company standards

PREFACE TO REVISED REPORT, 1989

Due to continuing changes in aircraft specifications the need has arisen to revise the data tables contained in the original issue of April 1981. Shell Aircraft London have supplied the latest helicopter data for inclusion in this revision. The opportunity has also been taken to revise the structural design guidelines of the original report by incorporating the method recommended by Lloyds Register of Shipping specifically for helideck design.

1. INTRODUCTION

This document details the minimum acceptable criteria for the design of helidecks on PETRONAS offshore installations. In general the PETRONAS design criteria will satisfy the requirements of the various worldwide regulatory bodies. However, due to the developing nature of offshore regulations, the local regulations should be reviewed prior to design work being undertaken.

Where design is subject to approval by a government agency, then it is recommended that the design criteria and methods be agreed prior to any design work being started. Agency requirements that are known to differ from those considered necessary by PETRONAS are highlighted together with recommended courses of action.

2. DESIGN HELICOPTER

The resultant design for a particular helideck is dependent upon the helicopters that will fly to and from the installation in question. The helicopters to be considered will have to be defined before design work is started. In general it is the largest, heaviest helicopter that will govern helideck design. It is essential, however, that the effects of all helicopters likely to be serving the installation are considered when designing the helideck.

3. LOCATION AND ACCESS

The location of a single landing area is often a compromise and for this reason aerodynamic and other testing of installation models may be required. Where the design parameters given below cannot be achieved, it may be necessary to impose restrictions upon helicopter operations, for example as a result of tests in relation to wind speed and/or direction. Where it is likely that the availability of a single landing area would impose severe restraints upon the regularity of helicopter operations, it may be advisable to provide two separate landing areas, probably diametrically opposed and each satisfying, as far as possible, the criteria given in this section.

The landing area should be accessible to the living accommodation and should be capable of being reached without passing through working areas. For helidecks with a high frequency of landings, e.g. North Sea area, access should be provided at two locations on opposite sides of the helideck. For less frequently used helidecks one stairway may be replaced by a vertical ladder.

Many helicopters have passenger access on one side only. Helicopter landing orientation (see Section 4) in relation to landing area access points is important. Embarking and disembarking passengers must not pass through helicopter rotor danger areas when the rotors are turning. These areas are usually associated with the tail rotor, but with certain modern aircraft the area swept by the forward part of the front rotor may also be a rotor danger area.

The landing area should be located so that a clear approach and take-off sector is available, preferably into the prevailing winds.

It should be least affected by structure-induced turbulence or by high temperatures and turbulence from the exhausts of gas turbines. Landing areas 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, turbulence, prevailing wind and turbine exhaust stack emissions must be determined for each installation. Where such effects cannot be directly determined, such as for large modularised decks or platform complexes with the decks in close proximity, then wind tunnel flow measurements should be performed. This information should be made available to the helicopter operator. Generally, the vertical component of air flows, resulting from wind of up to 25 metres per second, should not exceed ± 0.9 metres per second over the helideck at the main rotor height. Beyond the helideck this vertical wind velocity limitation applies to an envelope defined by a horizontal distance 2 'D' (see Section 4) measured from the edge of the helideck, and by an upward sloping line drawn from the edge of the helideck at main rotor heights at an angle of 30° to the horizontal. This restriction is limited to the obstacle free landing and take-off sector as defined in Section 4. The envelope described above is shown in Figure 1.

Where gas turbines are installed and where the exhaust gases may effect helicopter operations, some form of exhaust plume indication, for example by the production of coloured smoke, should be provided during helicopter operations. Unless it is obvious that the air temperature in the vicinity of the flight paths, to and from the landing area, will not be affected by the exhaust plume, a survey of ambient temperatures should be conducted. This should be done during periods when the wind is blowing directly from the turbine exhaust ducts towards the helideck. Where the ambient temperature is increased by more than 3°C the helicopter operator shall be advised.

It may be necessary in difficult design cases for some form of permanent heat sensor instrumentation to be installed to give guidance to the helicopter pilot on the temperature profile which may be encountered during operations at the installation.

Attention should be paid to the emission of vented gases from the platform which could be ingested by the helicopter engine intakes during the take-off or landing sequences.

4. SIZE AND OBSTACLE ENVIRONMENT

Helideck dimensions are defined in terms of a helicopter- related dimension 'D'. The installation's operations manual, and where required the Certificate of Fitness or equivalent, should as well as stating those helicopters which may use the helideck, state the maximum size 'D' for which the helideck area is considered suitable. Where the criteria described below cannot be met in full, then the relevant government agency and helicopter operator should be consulted with a view to defining any operational restrictions that may be considered necessary. Any operational restriction should be included in the operations manual and, where applicable, the Certificate of Fitness or equivalent.

Your attention is drawn to Figures 2, 3, 4 and 5.

For any particular type of single main rotor helicopter, the landing area should be sufficiently large to contain a circle of diameter 'D' equal to the overall length of that helicopter measured across the main and tail rotors in a fore and aft line. The circle of diameter 'D' should be unobstructed. For any helicopter with tandem main rotors a measurement across the main rotors in the fore and aft line is to be established as 'D'. A rectangular landing area for such helicopters should be provided with a minimum length of 0.9 'D' and with a minimum width of 0.75 'D'.

An approach and take-off obstacle-free sector should be provided above the helideck as detailed in Figures 2, 3 and 4. This sector should totally enclose the landing area and extend over an arc of at least 210°. For single main rotor helicopters the sector may originate from any point on the landing circles circumference. For tandem main rotor helicopters the sector must originate at the mid point of the inboard edge of the landing rectangle. Within this sector, and out to a distance of 1000 metres from the periphery of the landing area, only the following items may exceed the height of the landing area, but should not do so by more than 0.25 metres:

- i) the guttering or slightly raised kerb associated with the requirements in Section 6;
- ii) the lighting as required by Section 8.2;
- iii) the outboard edge of the safety net as required by Section 9;
- iv) handrails and other items associated with the landing area which are incapable of complete retraction or lowering for helicopter operations.

Within the remaining 150 degree sector, and out to a distance from the centre of the landing area circle or rectangular equal to 0.83 'D', objects should not exceed a height above the landing area of 0.05 'D'.

It is recommended that an obstacle-free sector is provided below the helideck. The provision of this sector will allow the helicopter pilot some air space in which to recover from a height loss during the later stages of approach or the early stages of take-off. Such an obstacle-free sector may be provided by defining an envelope in which all installation components must fit. This envelope is defined by a horizontal 180 degree arc measured from the centre of the aiming circle (see Section 8.1) and by a line with a downward gradient of 1 in 5 being constructed from each point on the edge of the helideck. Figure 5 shows the obstacle-free sector below the helideck as described above and defines its relationship with the 210° take-off and approach sector.

Note that current Norwegian regulations relating to size and obstacle environment differ from those outlined below. Prior to commencing design of a helideck intended for Norwegian waters, the current regulations will have to be studied. Any requirements more onerous than the above must be identified and incorporated into the design.

5. STRUCTURAL DESIGN

The following is applicable to the design of steel decks and Appendix 2 contains further details of the design method. The use of other materials for deck construction requires further detailed consideration. Requirements related to the design of aluminium decks may be found in Section 2.5.2 of Appendix 2.

The landing area and take-off area should be designed for the highest anticipated category of helicopter that will serve the installation.

There are basically three undercarriage configurations in use; these are shown in Figure 6 together with the terms used to describe undercarriage components. For the purpose of design it is to be assumed that the helicopter will land on:

- i) two skids of the skid-mounted helicopters (configuration 1, Figure 6) in which case the landing load per skid shall be half the total landing load;
- ii) the main gear (configuration 2, Figure 6) in which case the landing load per leg of the gear shall be half the total landing load;
- iii) the main and secondary gear (configuration 3, Figure 6) in which case the load distribution to each undercarriage shall be in proportion to the static loads they carry.

Note that one leg may have one or two wheels. The associated contact area plays an important role when considering the deck plate thickness of the helideck. The undercarriage configuration and contact areas of the tyres/skids should conform to values given by the helicopter manufacturer(s).

Consideration in the helideck design shall also be given to other types of loading such as the live loads in excess of the minimum live load (snow, personnel, cargo transfer, rotor down wash, etc.) of 0.5 kN/m^2 .

The operational loads (Section 5.1) and survival (emergency loading) loads (Section 5.2) shall be combined with environmental loads, dead loads and live loads.

The helideck consists of:

- I Deck plating
- II Deck secondary structure: stiffeners
- III Primary supporting structure: girders, pillars, trusses.

These terms will be used in the definition of the loads and allowable stress calculation methods to follow.

5.1 Operational condition

5.1.1 Loads

The operational (normal usage) load is defined as the heavy landing of the fully loaded design helicopter(s) which shall be positioned so as to produce the most severe loading condition for each structural member under consideration. The operational load shall be taken as $1.5 \times$ maximum take-off weight of the design helicopter (s). For example, for case ii) above helicopters the loading per leg is $0.75 \times$ maximum take-off weight.

For the design of the deck stiffening a minimum live load of 0.5 kN/M^2 shall be superimposed. For the design of the primary supporting structure in addition to the helicopter loads above a live load of 0.5 kN/M^2 plus the structural deadweight of the deck and stiffeners shall be applied. Simultaneously, a lateral loading of $0.5 \times$ the maximum take-off weight of the helicopter plus $0.5 \times$ the deadweight of the helideck shall be applied for design of the primary supporting structure (see load case (3) of Table 2.2.1, Appendix 2).

When the helideck is mounted on a mobile offshore platform, accelerations corresponding to operating environmental conditions shall be included in the maximum take-off weight.

5.1.2 Allowable stresses

For the operational condition the maximum allowable stresses are as follows (see Table 2.2.2 of Appendix 2):

Deck secondary structure (stiffeners) in bending: $0.718 \times F_y$

Primary supporting structure for combined bending and axial: $0.6 \times (F_y, 0.2\% \text{ proof stress or compressive buckling stress whichever is lesser})$

(where F_y - minimum specified yield stress of the material).

The thickness of the deck plating may be calculated by the method set out in Appendix 2. The primary supporting structure may be designed with the aid of direct calculation methods in conjunction with an appropriate design code (references 3 and 4).

5.2 Survival condition

5.2.1 Loads

The survival load is defined as the emergency landing of the fully loaded design helicopter(s) which shall be positioned so as to produce the most severe loading condition for each structural member under consideration. The survival load shall be taken as $2.5 \times$ maximum take-off weight of the design helicopter(s) multiplied by a factor f . The factor f shall either be 1.15 for landing decks forming the upper boundary of manned spaces, e.g. accommodation spaces, control rooms, etc., or 1.0 elsewhere.

For the design of the deck stiffening a minimum live load of 0.2 kN/m^2 shall be superimposed. For the design of the primary supporting structure in addition to the helicopter loads above a live load of 0.2 kN/m^2 plus the structural deadweight of the deck and stiffeners shall be applied. Simultaneously a lateral loading of $0.5 \times$ the maximum take-off weight of the helicopter shall be applied for the design of the primary supporting structure (see load case (2)) of Table 2.2.1, Appendix 2).

When the helideck is mounted on a mobile offshore platform, accelerations corresponding to operating environmental conditions shall be included in the maximum take-off weight.

5.2.2 Allowable stresses

For the emergency landing condition the maximum allowable stresses are as follows (see Table 2.2.2 of Appendix 2):

Deck secondary structure (stiffeners) in bending: F_y

Primary supporting structure for combined bending and axial: $0.9 \times (F_y, 0.2\% \text{ proof stress or compressive buckling stress whichever is the lesser})$

(where F_y - minimum specified yield stress of the material).

The thickness of the deck plating may be calculated by the method set out in Appendix 2.

The prime consideration for the specification of the above maximum allowable stresses and the proposed calculation methods is that under emergency landing conditions the deck plating and the secondary structure are allowed to be subject to gross deformations in contrast with the primary support structure which should remain intact.

5.3 Overall distributed loading

5.3.1 Loads

The helideck shall also be assessed for a distributed loading of 2 kN/m^2 over the entire landing area. This load is to cover for temporary loading conditions of the helideck and is to be considered without the effects of helideck or helicopter self-weight or any horizontal loading.

5.3.2 Allowable stresses

Deck secondary structure (stiffeners) in bending: $0.6 \times F_y$

Primary supporting structure in bending: $0.6 \times F_y$

For combined bending and axial: $0.6 \times (F_y, 0.2\% \text{ proof stress or compressive buckling stress whichever is the lesser})$

(where F_y - specified minimum yield stress of the material).

The thickness of the deck plating may be calculated by the method set out in Appendix 2.

5.4 Installation

Loads experienced during helideck construction including static and dynamic forces that occur during lifting, loadout and transportation should be considered in accordance with the appropriate design code. In particular decks are often fabricated upside down to facilitate down-hand welding of stiffeners to deck plate. An assessment of the stresses incurred during the process of uprighting the structure should be made.

6. SURFACE

The landing area should have an overall coating of non-slip material and all coloured markings on the surface of the landing area should be made with non-skid materials. Attention must be paid to the durability of the coating. Flaking of the material must be prevented since the flakes, especially with aggregate present for non-slip purposes, are a serious hazard to helicopter engines.

To ensure adequate drainage on field installations, the landing area should be laid to a fall* or cambered to prevent rainwater and fuel spills from remaining on the deck. 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 or a slightly raised kerb should be provided around the perimeter to prevent spilled fuel from falling on to the other parts of the installation and to conduct the spillage to a safe place.

A tautly stretched rope netting should be provided to aid the landing of helicopters with wheeled undercarriages in adverse weather conditions. It is preferable that the net be made of 20 mm diameter sisal. The maximum mesh size should be 200 mm. The net should be secured every 1.5 metres around its perimeter and tensioned such that the centre of the net cannot be lifted more than 250 mm. Netting of material other than sisal may be used subject to similar properties being provided. Any proposed material should be subject to review by:

- i) the relevant government agency;
- ii) the helicopter operator,

or in the event of there being no government agency and the operator being unknown at the design stage, Shell Aircraft Ltd. London. Net sizes are generally considered as follows:

- small : 6 metres by 6 metres
- medium: 12 metres by 12 metres
- large : 15 metres by 15 metres.

Appendix 1 gives helicopter data and includes the net sizes to be used for the various aircraft. For helidecks that will be used by skid equipped helicopters, the advantages of improved stability provided by the net may be offset by the risk of the skids becoming trapped. In such cases the use of netting should be left to the discretion of the helicopter operator.

Some operating companies have provided wooden grills in lieu of a rope net. Such a solution can increase operating limits such as allowable heave, pitch and wind speed. The dimensions of the wooden grid mesh will be specific to individual helicopter types, and if it is decided to adopt this solution, then the design should be produced in cooperation with the helicopter operator, and approval sought from the relevant government agency if applicable.

7. TIE DOWN POINTS

Sufficient tie down points should be provided, so located and of such strength and construction as to be suitable for securing, in all conditions, the helicopter types for which the landing area is designed. They should be fitted flush with the surface of the helideck, in order to reduce the risk of tyre or skid damage, and adequately drained. Advice on the configuration of the tie down points should be obtained from the helicopter operator or, in the event of the operator not being known at the design stage, Shell Aircraft.

* typically 1:100

8. VISUAL AIDS

The installation should display its registered name or designation in a manner which is visible from helicopters approaching the installation.

Marking and lighting of the helicopter landing area will enable this area to be identified and facilitate its use by day and night respectively. Marking and lighting of obstacles will help to ensure safe standard of separation from such obstacles.

8.1 Helicopter landing area - markings_(ref. Figures 7 and 8)

The colour of the landing area should be dark grey or dark green and its perimeter should be clearly marked with a white painted line about 0.3 metres wide.

The 210 degree obstacle-free sector for approach and take- off, as defined on Figures 2, 3 and 4 should be marked on the helideck by two black lines each 1.0 metres long and 0.1 metres wide, which will form the angle (see Figure 7c).

Where the helideck is too small to allow the actual angle to be marked, two black lines of the same size but with added arrow head should be painted so that they point up the arms of the 210 degree sector (see Figure 7d). In both cases the angle and helicopter 'D' size in metres should be painted in the apex of the angle in letters and figures of about 0.1 metres high. Where a helideck has been accepted which does not meet the full requirements, the helicopter 'D' size in metres and accepted angle should be painted in the apex.

Aiming circles must be provided. The position, number and diameter of which will depend upon the size of the landing area, the proximity of objects and the helicopter type(s) which it is intended to operate onto the installation. In addition to the aiming circles and markings, a white letter 'H' should be located within the aiming circles (see Figures 7a and 7b).

The following guidance is given on the standardised markings which will be required for landing areas to be used by the larger helicopters of types Sikorsky S61N, Pumas 330 and 332, Bell 214ST and Boeing 234LR. In certain areas Sikorsky S58T helicopters may be used. For completeness, guidance for these helicopters is included. The guidance is only applicable to those landing areas which fully meet the criteria in respect of size and approach and take-off sector provision. Normally, unless the 150° sector has been swung to provide obstruction clearance (see Figures 2, 3 and 4), the centre of the aiming circle will be located on the bisector of the 210 degree approach and take-off sector and at the distance in from the outboard edge of the landing area indicated below.

a) S58T-helicopters

Landing area	:	for 'D' size of 20.08 metres.
Aiming circle	:	inner radius 3 metres, outer radius 4 metres (i.e. 1 metre wide) painted YELLOW. Centre located 8.25 metres from outboard edge of the landing area, see Figure 7b. Figure 7d shows the aiming circle for these helicopters located within the S61N aiming circle.

For cases where S61N and S58T helicopters will use the same helideck, it is permissible to provide only the S61N aiming circle if so desired.

Helicopter landing	:	fuselage across the circle with main wheels on the edge position of the aiming circle.
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- b) S61N helicopters
- Landing area : for 'D' size of 22.2 metres.
- Aiming circle : inner radius 6 metres, outer radius 7 metres (i.e. 1 metre wide), painted YELLOW. Centre located 9 metres from outboard edge of landing area (see Figures 7c and 7d).
- Helicopter landing : fuselage across circle with pilot's eye line above edge position edge of the aiming circle.
- c) Puma 330 helicopters
- Landing area : for 'D' size of 18.10 metres.
- Aiming circle : as for S61N helicopter.
- Helicopter landing position : as for S61N helicopter position
- d) Puma 332 helicopters
- Landing area : for 'D' size of 18.46 metres.
- Aiming circle : as for S61N helicopter.
- Helicopter landing position : as for S61N helicopter position
- e) Bell 214ST helicopters
- Landing area : for 'D' size of 18.97 metres.
- Aiming circle : As for S61N helicopter.
- Helicopter landing position : as for S61N helicopter position
- f) Boeing 234 LR 'Chinook' helicopters
- Landing area : for 'D' size of 30.18 metres, length of rectangle 27.18 metres (0.9 'D'), width of rectangle 22.65 metres (0.75 'D').
- Aiming circle : dimensions as for S61N, centre located at centre of rectangle unless an S61N is to use the helideck, in which case the centre shall be located 9.5 metres from the outboard edge of the helideck. Alignment lines, 1 metre wide, shall extend longitudinally from the periphery of the circle to the edges of the landing area (see Figure 8) and shall be painted YELLOW.

Dimensions of 'H' are given in Figure 7a. The 'H' is to be painted WHITE and is to be centrally located in the aiming circle(s) and orientated so that the central horizontal bar of the 'H' is on the bisector of the obstacle-free sector. Should the obstacle free sector be swung as indicated on Figure 2 then the bisector will not pass through the centre of the landing circle. In this case the horizontal bar of the 'H' should be located on the centre of the aiming circle but parallel to the bisector.

No specific aiming circle markings are proposed for smaller helicopter types, but such smaller helicopters will be fully clear of obstructions if they land in the centre of the aiming circles described above.