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The structural design of helidecks for offshore installations

OFFSHORE TECHNOLOGY REPORT

2001/070

The structural design of helidecks for offshore installations

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FOREWORD

This document provides technical information previously contained in the Fourth Edition of the Health and Safety Executive's *'Offshore Installations: Guidance on Design, Construction and Certification'* (1990 edition plus amendments)[(1)]. The 'Guidance' was originally published in support of the certification regime under SI289, the Offshore Installations (Construction and Survey) Regulations 1974[(2)]. However, SI289 was revoked by the Offshore Installations (Design and Construction, etc) Regulations, 1996, which also introduced the verification provisions into the Offshore Installations (Safety Case) Regulations, 1992. The 'Guidance' was formally withdrawn in its entirety on 30 June 1998 (see HSE OSD Operations Notice 27[(3)]).

The withdrawal of the 'Guidance' was not a reflection of the soundness (or otherwise) of the technical information it contained; some sections (or part of sections) of the 'Guidance' are currently referred to by the offshore industry. For this reason, after consultation with industry, relevant sections are now published as separate documents in the HSE Offshore Technology (OT) Report series.

It should be noted that the technical content of the 'Guidance' has not been updated as part of the re-formatting for OTO publication, although prescriptive requirements and reference to the former regulatory regime have been removed. **The user of this document must therefore assess the appropriateness and currency of the technical information for any specific application. Additionally, the user should be aware that published sections may cease to be applicable in time and should check with Operations Notice 27, which can be viewed at http://www.hse.gov.uk/hid/osd/notices/on_index.htm, for their current status.**

1. INTRODUCTION AND SCOPE

This Offshore Technology (OT) Report provides information on the structural design of helidecks for Offshore Installations and should be read in conjunction with the latest edition of the CAA's 'Offshore Helicopter Landing Areas: a Guide to Criteria, Recommended Minimum Standards and Best Practice' CAP 437[4].

The information is based on guidance previously contained in Section 55 of the Fourth Edition of the Health and Safety Executive's 'Offshore Installations: Guidance on Design, Construction and Certification'[1] which was withdrawn in 1998. Only the information contained in Section 55.5 – Structural Design has been retained in this document. The other information has been superseded by CAP 437[4]. As discussed in the Foreword, whilst the text has been re-formatted for Offshore Technology publication the technical content has not been updated. The appropriateness and currency of the information contained in this document must therefore be assessed by the user for any specific application.

2. DESIGN CONSIDERATIONS

Helidecks may be designed for a specific type of helicopter though greater operational flexibility will accrue from a classification system of design. It is suggested that the landing and take-off area should be designated for the heaviest and largest helicopter it is anticipated will use the platform (see Table 1). The design would also need to address other types of loading such as personnel, traffic, snow, freight, re-fuelling equipment, etc. For the purpose of design, it can be assumed that a single main rotor helicopter will land on the wheel or wheels of two main under-carriages, or skids if fitted, and that a tandem main rotor helicopter will land on the wheel or wheels of all main under-carriages simultaneously. It is suggested that the concentrated under-carriage loads should normally be treated as point loads but where advantageous a tyre contact area may be assumed in accordance with the manufacturer's specification.

For single main rotor helicopters, the total loads imposed on the structure would need to be taken as concentrated loads on the under-carriage centres of the specified helicopter and divided equally between the two main under-carriages.

For tandem main rotor helicopters, the total loads imposed on the structure would need to be taken as concentrated loads on the under-carriage centres of the specified helicopter and distributed between the main under-carriages in the proportion in which they carry the maximum static loads.

The maximum take-off weight and under-carriage centres for which the platform has been designed and the maximum size and weight of helicopter for which the deck is suitable should be stated.

Plastic design may be applied for the deck plating and stiffeners only but elastic design should be applied to the main supporting members (i.e. girders, trusses, pillars, columns etc.).

The design criteria which follow are based on helicopter size and weight. These parameters are summarised in Table 1 for commonly used helicopters.

Table 1 Helicopter weights and dimensions

Type	Helicopter weights and dimensions				
	D' Value (metres)	**Maximum height (metres) ***	**Rotor diam. (metres) ***	**Max. weight (kg)**	**Landing net size**
Bolkow Bo 105D	11.81	3.80	9.90	2300	Not Required
Bolkow 117	13.00	3.84	11.00	3200	Not Required
Agusta A 109	13.05	3.30	11.00	2600	Small
Dauphin SA 365N2	13.68	4.01	11.93	4250	Small
Sikorsky S76 B & C	16.00	4.41	13.40	5307	Medium
Bell 212	17.46	4.80	14.63	5080	Not Required
Super Puma AS 332L2	19.50	4.92	16.20	9150	Medium
Super Puma AS 332L	18.70	4.92	15.00	8599	Medium
Bell 214ST	18.95	4.68	15.85	7936	Medium
Sikorsky S6 IN	22.20	5.64	18.90	9298	Large
EH 101	22.80	6.65	18.60	14290	Large
Boeing BV234LR** Chinook	30.18	5.69	18.29	21315	Large

* With skid fitted helicopters, the maximum height may be increased with ground handling wheels fitted.

** The BV234 is a tandem rotor helicopter and in accordance with ICAO Annex 14 Volume II, the helideck size is 0.9 of the helicopter D' value, i.e. 27.16m .

3. LOADS

3.1 DESIGN LOADS FROM A HELICOPTER LANDING

It is suggested that the helicopter landing area should be designed to withstand all stresses that result from a helicopter landing, taking the following into account:

a) Dynamic load due to impact landing.
This needs to cover both a heavy normal landing and an emergency landing. For the former, an impact load of 1.5 x maximum take-off weight (MTOW) of the helicopter is suggested, distributed as described above. This would need to be treated as an imposed load, applied together with the combined effect of b) to f) below and would need to be positioned in various positions on the landing area so as to produce the most severe landing condition for each element affected. For the latter an impact load of 2.5 x MTOW is suggested for application in any position on the landing area together with the combined effects of b) to f) inclusive.

b) Sympathetic response of landing platform.
The dynamic load (see a) above) needs to be increased by a structural response factor depending upon the natural frequency of the deck structure when considering the design of supporting beams and columns. Unless values based upon particular under-carriage behaviour and deck frequency are available, it is suggested that a minimum structural response factor of 1.3 should be used. For the Boeing BV234LR Chinook where test data for both front and rear under-carriages has been reviewed, the structural response factor may be modified as follows:

Natural frequency of deck structure	Structural response factor
Between 17 and 25 Hz	1.3
Between 25 and 50 Hz	1.15
Between 50 and 100 Hz	1.10

c) Overall superimposed load on the landing platform.
To allow for snow load/personnel etc., in addition to the wheel loads an allowance of 0.5 kN/m^2 needs to be included in the design.

d) Lateral load on landing platform supports.
The supports of the platform need to be designed to resist concentrated horizontal imposed loads equivalent to 0.5 x maximum take-off weight of the helicopter, distributed between the under-carriages in proportion to their vertical loading. This would need to be applied in the direction which will produce the most severe loading conditions for each element concerned.

e) Dead load of structural members.

f) Wind loading.
Wind loading needs to be allowed for in the design of the platform in accordance with OTO Report 2001 010. This should be applied in the direction which, together with the imposed loading in d) above, will produce the most severe loading condition for each element concerned.

3.2 DESIGN LOADS FOR A HELICOPTER AT REST

It is suggested that the helicopter platform should be designed to withstand all stresses that result from a helicopter at rest, taking the following into account:

a) Imposed load from helicopter at rest.
   The entire helicopter platform needs to be designed to carry an imposed load equal to the maximum take-off weight of the helicopter. This would need to be distributed between all the under-carriages of the helicopter. It would need to be applied in various positions on the helideck so as to produce the most severe loading condition for each element affected.

b) Overall superimposed load, dead load and wind load.
   The values for these loads need to be the same as those given above for helicopters landing and should be used in combination with a) above. Consideration should also be given to the additional wind loading from a secured helicopter.

c) The effect of acceleration forces and other dynamic amplification forces arising from the predicted motions of the Installation in the appropriate environmental conditions.
   These need to be considered where applicable.

4. REFERENCES

1. Department of Energy. Offshore Installations: Guidance on Design, Construction and Certification, 4th Edition. HMSO, Consolidated Edition, 1993 (plus Amendment No. 3, 1995). [Withdrawn 1998 by Operations Notice 27].

2. SI 1974 / 289 – The Offshore Installations (Construction and Survey) Regulations 1974, HMSO, 1974. [Revoked and has been replaced by SI 1996 / 913 – The Offshore Installations and Wells (Design and Construction etc.) Regulations, 1996 – ISBN: 0 110 54451 X].

3. Health and Safety Executive. Status of Technical Guidance on Design, Construction and Certification. Operations Notice 27. Revised and Reissued, August 1998.

4. Civil Aviation Authority. CAP 437 – Offshore Helicopter Landing Areas – A Guide to Criteria, Recommended Minimum Standards and Best Practice. 3rd Edition. 1998.

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