



MINISTRY OF DEFENCE

Defence Infrastructure Organisation

SUBJECT: Condition Inspection and Certification of Proposed, Historic and Existing Hangar Structures and Other Wide Span Building Structures

Practitioner Guide 05/11

Estate
Management

Document Aim:

The aim of this Practitioner's Guide is to set out the requirements to be adopted for the Condition Inspection and Certification of proposed, historic and existing hangar structures and other wide span building structures on the MOD estate.

Document Synopsis:

This document details the procedures to be adopted during the Condition Inspection of historic and existing hangar structures on the MOD estate. The policy also assists the Inspector in determining the remaining effective life of a historic or existing structure and to ensure the safest environment as far as reasonably practicable for all those using the building. Procedures are stated for confirming at hand over that a new hangar structure has been constructed to the agreed design and drawings and that it is fit for its intended purpose.



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Who should read this:

All stakeholders involved in the whole life management of Proposed, Historic and Existing Hangar Structures and Other Wide Span Building Structures on the defence estate, i.e. CEstOs, Top Level Budget Holders, Project Sponsors, MOD Project Managers and others within the IPT (for both Prime, PFI/PPP and traditionally procured contracts), Defence Infrastructure Organisation Advisors and Site Estate Representatives with responsibility for MOD projects.

When it takes effect: Immediate

When it is due to expire: when rescinded

Equality And Diversity Impact Assessment

This policy has been Equality and Diversity Impact Assessed in accordance with the Department's Equality and Diversity Impact Assessment Tool against:

Part 1 Assessment Only (no diversity impact found)

Document Control

Distribution

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KEY POINTS TO NOTE:

- This Practitioner Guide (PG) updates and supersedes Technical Bulletin 02/05 “Safety audit and technical inspection of WWII hangar structures”.
- The term “Condition Inspection” (CI) used in this PG has replaced the term “Technical Inspection” used in previous documents. Similarly the term “Structural Appraisal” (SA) used in this PG has replaced the term “Professional Appraisal”.
- The term “hangar structures” in this PG is deemed to include “Other Wide Span Building Structures exceeding 12m”.
- This PG shall be used in conjunction with PG04/11 “Structural Appraisal and Certification of Proposed, Historic and Existing Hangar Structures and Other Wide Span Structures”.

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Form R105 - Hangar Structure Condition Inspection – Summary Report

1.0 INTRODUCTION

- 1.1 The contents of this PG are mandatory. No work involving expenditure on any Ministry of Defence (MOD) account is to be entered into without authority from the appropriate MOD officer for that location or facility.
- 1.2 This PG is to be brought to the attention of all CEStOs, Top Level Budget Holders, Project Sponsors, MOD Project Managers and others within the IPT (for both Prime, PFI/PPP and traditionally procured contracts), Defence Infrastructure Organisation (DIO) Advisors and Site Estate Representatives with responsibility for MOD projects.
- 1.3 Compliance with this PG is required to meet the MOD's Statutory Duties under the Health and Safety at Work etc Act 1974, in particular:

The Workplace (Health, Safety and Welfare) Regulations;
The Construction (Design and Management) Regulations;
Management of Health and Safety at Work Regulations; and
The Work at Height Regulations.

- 1.4 This PG details the requirements for procedures to be adopted during the Condition Inspection (CI) of proposed, historic and existing hangar structures on the MOD estate. They also assist the Inspector in determining the remaining effective life of a historic or existing structure and ensure the safest environment as far as reasonably practicable for all those using the building.
- 1.5 Procedures for the SA of hangar structures are provided in PG 04/11.
- 1.6 The primary deliverables of the CI are:
 - a. to verify that the structure and the building fabric, including access systems, doors, outriggers and supports are in a satisfactory condition, are fit for purpose and can be safely used until the next CI or SA;
 - b. to verify the hangar structure and fabric including the doors and supports have adequate capacity to withstand all the loads applied;
 - c. to provide information for inclusion in the forward maintenance register;
 - d. to confirm at hand over that the new hangar structure has been constructed to the agreed design and is fit for its intended purpose;
 - e. to verify that all the fixed access systems are fit for purpose;
 - f. for historic and existing hangar structures, to make suitable recommendations on how to overcome structural or access deficiencies, and to provide risk management in respect of such deficiencies where they cannot be reasonably overcome;
 - g. To provide documentation and certification of the CI i.e. Forms R104 and R105 as explained in 3.5.

2.0 APPLICATION OF PRACTITIONER GUIDE

2.1 In this PG reference to a hangar structure generally refers to building structures used for the purposes of:

- a. storing and servicing of aircraft
- b. bulk vehicle storage
- c. bulk equipment and spares storage
- d. workshops
- e. military working spaces
- f. sports halls and recreation facilities
- g. exhibition halls
- h. offices.

The aforementioned examples are not exhaustive and the hangar structure may be used for other purposes not listed above. These types of structure are generally characterised by having clear internal spaces of similar magnitude and dimensions to the overall building footprint. They are composed of slender members or latticework spanning lengths greater than 12m. Other structures with spans of less than 12m may also be subject to the provisions of this PG, see 2.2(d) below.

Often on the MOD estate structures originally designed as aircraft hangars have been re-utilised for other purposes such as those listed above and although there has been a change in use, structural deficiencies that can be present may not have been adequately addressed or risk assessed.

2.2 The structures covered under this PG are as follows.

a. Proposed New Hangar Structures

These structures are generally new steel lattice or steel beam portal framed structures but may occasionally be built using concrete portal frames or composite construction. All new hangar structures are to have a CI carried out after site work has been completed and prior to handover of the structure. This is to confirm that the building has been constructed in accordance with the agreed design and drawings and to report any construction defects. The term 'new hangar' is deemed to include any type of pre-fabricated proprietary structural system or building.

b. Historic and Existing Hangar Structures.

A large proportion of the historic steel hangar structures covered by this PG were built in the period leading up to and during the Second World War (WW II era). With the war looming, hangars were constructed hastily and as a consequence, normal steel and material quality checks were often not rigid and structural designs allowed for shorter design life and smaller loadings. The CI is to highlight any emerging defects that have arisen since the last CI or SA, and to make recommendations for works where deficiencies are noted.

Design guides for the four most common WW II hangar types on the MOD estate (types Bellman, T2, C, and J/K) have been produced by Defence Infrastructure Organisation. Copies of the guides are available on the DIO Intranet and the DIO external web page, in the download area at the following address:

www.MOD.uk/defenceestates

The design guides include valuable information on several topics including hangar identification and typical loadings. It is recommended that these are studied prior to the inspection process.

For existing WW II era hangars it is important to identify each structure type correctly, as some have only minor distinctions between them. Reference should be made to Technical Bulletin (TB) 02/02, World War II Hangars – Guide to Hangar Identification. Any doubts about identification of the structure can be clarified with the Subject Contact Point.

c. Other Wide Span Building Structures

These include all structures with clear spans of 12m or greater. The majority of these structures are fabricated from steel or reinforced concrete but may include glue laminated timber or composite construction.

d. Structures of less than 12m Span

Depending on the type and use of the building, those structures with clear spans of less than 12 metre width may also be susceptible to sway-effects and second-order instability. In these circumstances they shall be appraised as per the requirements of this PG, dependent upon risk assessment, to ensure that the integrity of the structure is not compromised by the activities carried out in or on it, for example, structures with gantry cranes, structures subject to dynamic or non-static loads, structures with activities that are sensitive to building movement, etc. Further advice may be sought from the Subject Contact Point.

3.0 REQUIREMENT

3.1 General

All hangar structures because of their age, deterioration, wear and tear, damage, inadequate maintenance and other factors require a CI to be carried out. The consequences of a failure of the structure, or elements of the structure, are significant both in terms of injury to those working within, to members of the public and in terms of the replacement costs of the structure and the goods stored within which may be of strategic importance and operationally sensitive in nature.

It is required that a CI shall be undertaken on the following occasions:

- a. at the specified interval;
- b. prior to the "Hand over" of any new hangar structure;
- c. prior to the acceptance of any refurbishment works;
- d. following referral by a Competent Person.

3.2 Scope of the CI

A CI shall be a physical inspection of the structure and fabric of a hangar only. There is no requirement to conduct a numerical analysis as part of the process.

The CI is to verify that the condition of all areas of the structure, including but not limited to, structural frame members, doors, door outrigger frames/supports, wall/roof cladding, rainwater systems, are in a satisfactory condition, are fit for purpose and can be safely used until the next SA (see PG 04/11). It is intended as a mid point review between the more intensive SAs to ensure that any emerging defects, deterioration or damage are noted and remedial works carried out.

A thorough review of all existing information contained in previous CIs, SAs, and all other available reports is to be carried out in order to ascertain the condition of the structure. All information, as far as reasonably practicable, is to be made available to the Inspector before the inspection begins.

For structures where inadequate records are available, a programme must be established for the undertaking of the SAs in accordance with PG 04/11.

It is the responsibility of the Inspector, before the inspection date, to establish his access requirements and locate concealed areas which may need to be exposed. Where necessary, obstructions including false ceilings and wall panelling shall be removed to gain sufficient access to carry out a thorough inspection.

The contents of a CI report are outlined in Annex A.

All proposed new and refurbishment works are required to undergo a CI as part of the hand over process. The CI shall consist of physically inspecting the "As Built" new works and confirming that these are compliant with the agreed design and drawings. See 3.7 below.

3.3 Structural Deficiencies

If the CI concludes the hangar to be potentially inadequate in respect of structural integrity, or in any other way be unsafe because of any noted deterioration, defects or damage then the client organisation responsible for its maintenance shall be duly notified. The hangar shall then be subject to a full SA as detailed in PG 04/11 and an Emergency Action Plan shall be issued dependent upon the findings.

Where recommendations are made to carry out major refurbishment works to a structure, then the report shall state the extent of the refurbishment that will be sufficient to enable lifting of all existing operational restrictions, as outlined in any extant Emergency Action Plan or SA.

If the CI identifies any deterioration, defects or damage to any part of the building fabric that does not present an immediate danger but if not rectified will further deteriorate to the extent that structural strength and stability are compromised, then the frequency of CI is to be increased, as per paragraph 3.4 below.

When conducting a CI the Appraiser is to note in his report any unsafe occurrence whether this is a defect of the structure or otherwise.

3.4 Frequency of Inspection

A Condition Inspection shall be undertaken on the following occasions:

- a. at a maximum of 2½ years (30 months) i.e. mid-way between SAs;
- b. at lesser intervals when recommended by a previous SA;
- c. at “hand-over” of any new works including refurbishments;
- d. following an incident in which significant damage or structural distress has been noted by a Competent Person.

The above inspection frequencies should be considered as the maximum default position and it may be necessary to reduce inspection intervals to accommodate local conditions and types of structure.

Increasing the frequencies between CIs is not a substitute for conducting an SA when deterioration is noted that is compromising structural strength and stability and is causing the structure to become dangerous. Its purpose is to actively monitor identified deterioration such that identified defects and damage are rectified in a timely manner.

3.5 Function of the Forms

In addition to the report detailed in Annex B, the CI shall be recorded by the completion of the following DE forms:

- a. Form R104 - Condition Certificate

The purpose of this form is to provide a concise summary of all the defects identified during the CI. It is also used for certifying that all remedial works have been carried out to a satisfactory standard and according to the agreed design and drawings. The condition summary covers the structure, fixed access systems, anchorage points, doors and supports. The form is to state if an Emergency Action Plan is in place. A brief description of any recommended remedial works is provided.

The validity of the certificate shall be stated on the form.

The Form R104 is to be completed and signed by a Competent Person.

b. Form R105 – Summary Report

The purpose of this form is to prioritise the defects identified and highlight those that are creating dangerous circumstances. It is to be used as the basis for planning remedial works in order of priority and for financial planning as per budget cost estimates that are entered on the form.

The recommended works are divided into three priorities: Urgent Repairs; Routine Repairs and Preventative Maintenance. Estimated costs are to be entered on the form for each element of the works.

The Forms R105 is to be completed and signed by a Competent Person.

3.6 Validity of Certification

Certificates shall be valid for a period of 30 months or a shorter period if deemed necessary by the Inspector. The validity of the certification is to be stipulated by the Inspector as being appropriate for the type of structure and its condition. The statements contained in the certification reflect the situation at the time of inspection but consideration is to be made of the projected condition of the structure during the period of validity.

For routine inspections undertaken up to six weeks before the end of the expiry date the new certificate may be dated 30 months (or lesser period if considered appropriate) from the original certificate expiry date.

3.7 Validation of Form R104 Following Completion of Remedial or New Works

All works shall be undertaken by competent contractors working in compliance with the Construction Design and Management Regulations. Where only Priority 2 or 3 works have been identified, they will not preclude occupation under normal circumstances and therefore, upon completion of the works, a full CI is not required to re-validate the Form R104.

Where Priority 2 or 3 works (see Annex A) have been carried out the Inspector is to assess the works upon completion. The Inspector is to confirm that works have been carried out in accordance with the agreed design and drawings and annotate the extant Form R104 accordingly.

Where Priority 1 works (see annex A) have been undertaken, the structure shall be inspected and a new Form R104 is to be signed before normal occupation can resume.

Upon completion of a proposed new structure within the provisions of this PG, the CI shall consist of inspecting the new works and comparing its "As Built" condition to the agreed design and drawings. If the constructed works are in compliance, then the Form R104 is to be signed to reflect this. Any defect or non-compliant items are to be noted on the form.

3.8 Competent Persons

A CI shall be carried out by, and all certificates signed by a Competent Person. A Competent Person shall:

- a. have an HNC or equivalent in Civil, Structural or related engineering subject;
- b. have a minimum of three years collective relevant experience in the inspection and construction of the type and complexity of the building structure involved.

The above requirements are to be applied in all cases, except where prior agreement is reached with the Subject Contact Point.

4.0 REFERENCES

Related DIO Publications

Defence Functional Standard 15 – Guide to World War II hangars 01 – Bellman hangar.

Defence Functional Standard 16 – Guide to World War II hangars 02 – Type T2 hangar.

Design and Maintenance Guide 13 – Mechanical Transport Facilities.

Design and Maintenance Guide 24 - The design and maintenance guide for the Type 'C' hangar structure.

Design and Maintenance Guide 25 - The design and maintenance guide for the Type J/K hangar structures.

TB 99/29 – Hangars - Safety of structure - Recommendations for users during adverse weather conditions.

TB 99/30 – Hangars and industrial buildings - Inspection, maintenance, adjustment and use of large sliding and folding doors.

TB 99/31 – Hangars – Guidance on works during hangar refurbishment.

TB 99/32 – Hangars - Bellman Type - Structural safety during adverse weather conditions.

TB 01/45 - Design and Maintenance Guides: Guide to World War II Hangars. DMG 24 - 03 Type C Hangar, DMG 25 - 04 Type J/K Hangar.

TB02/02 - Hangar Identification.

HSWN 01/02 – Inspection of hangar doors, Door Top Guides, Type C Hangars.

HSWN 02/08 - Inspection of Hangar Doors, Door Tops Guides, Supports and Door Stops. Type C and other similar Hangars.

Safety Alert 01/11 – Reminder – Inspection of Hangar Doors, Door Top Guides, Supports and Door Stops.

Safety Alert 02/11 – Structural Inspections of Hangars During Adverse Weather

Practitioner Guide PG 03/10 – Fixed Access Systems

Practitioner Guide PG 04/11- Structural Appraisal and Certification of Proposed, Historic and Existing Hangar Structures and Other Wide Span Building Structures

5.0 ANNEXES

CONDITION INSPECTION REPORT CONTENTS

- A.1 If, within a full CI report, any reference is made to another report, then the appropriate section of that report may, if practicable, be reproduced within the CI report with the source acknowledged. Alternatively it should be listed in an annex.
- A.2. The CI shall consider the following aspects, though the list is not limited:
- a. the site, including adjacent external ground levels;
 - b. the main body of the hangar structure covering main and secondary structural frames / members;
 - c. surface protection system;
 - d. where applicable, crane gantries, lifting beams and other fixed lifting points, including supports to these items;
 - e. where applicable, annexes, including load bearing masonry structures ;
 - f. floor slab areas;
 - g. walls, masonry/concrete or others;
 - h. hangar doors and outrigger support frames, including guides, tracks and stops;
 - i. roof and wall cladding systems including roof lights and glazing system;
 - j. rainwater goods and drainage systems;
 - k. fixed high level access systems, including any fall arrest systems and anchor points;
 - l. lightning protection system.
- A.3 The contents of the report shall be set out as follows. Where appropriate the information should be presented in tabular format:

| | |
|--------------------------------------|---|
| Introduction | including a general description of the location of the hangar, hangar type, its usage and the reports contents and objectives |
| Inspection Summary | details of inspection teams including names of inspectors, dates and scope of the inspection |
| Maintenance Condition Summary | a general summary of the condition of the structures and defects identified |
| Maintenance Cost Summary | a summary table indicating the estimated maintenance costs of the three priorities of maintenance work (see A.7) |

The CI report is to be prepared under the guidance of a suitably experienced Competent Person.

A.4 Emergency Action Plan

The CI should include a check for the existence of an Emergency Action Plan for the hangar structure. Any Emergency Action Plan shall be implemented in accordance with Technical Bulletin 99/29 "Hangars – Safety of Structure – Recommendations for Users During Adverse Weather Conditions" and TB 99/32 "Hangars - Bellman Type - Structural Safety During Adverse Weather Conditions" as appropriate to allow safe use of the hangar.

The Inspector shall record if the Emergency Action Plan is in place on Form R104. If a valid Emergency Action Plan is not in place, the MOD building user/custodian responsible for the hangar shall be informed immediately in writing.

A.5 Annexes

Annexes to the report shall include the following:

| | |
|-----------------------------|---|
| References | all source documents and codes used in the inspection process |
| Certification | completed Forms R104 and R105 |
| Serious Fault Sheets | a description and colour photograph of each serious fault |
| Photographs | sufficient photographs are to be taken to illustrate the findings in the report |

A.6 Serious Fault Sheet

Should the Inspector discover any items that may constitute an immediate danger, then a Serious Fault Sheet is to be prepared and the DIO Site Estate Representative informed in writing immediately.

A.7 Recommended Works Priorities

The Form R105 is to be prepared for the structure inspected. All recommended remedial works are to be listed on the form under one of the three headings:

- a. Priority 1 - Urgent Repairs. These remedial works are those that are of the highest priority and could constitute a risk to structural collapse and to human life. They are the minimum works required in order to ensure safe occupation of the hangar.


If Priority 1 – Urgent Repairs are necessary, the DIO Site Estate Representative shall be notified immediately in writing who shall initiate a risk assessment of the structure. Based upon the results of the risk assessment, the Site Estate Representative is to determine whether the hangar can remain in use and occupation. A programme shall be put into effect for carrying out remedial works in order to ensure safe use and occupation of the hangar;

- b. Priority 2 - Routine Repairs. These items are required to remedy unsatisfactory defects which, if not undertaken within a reasonable timescale, may result in qualification of the Form R104;
- c. Priority 3 - Preventative Maintenance. These are minor maintenance items which, if not undertaken, might incur disproportionate future expenditure, or are desirable for the reasons stated on the Form R105. Such defects do not warrant inclusion on Form R104.

DEFENCE INFRASTRUCTURE ORGANISATION FORMS

Form R104 – Condition Certificate

Form R105 – Summary Report

| | | | |
|--|---|--|-------------------------|
| DEFENCE INFRASTRUCTURE ORGANISATION |  | HANGAR STRUCTURE CONDITION INSPECTION CONDITION CERTIFICATE (Page 1 of 2) | R104 Aug 2011 |
|--|---|--|-------------------------|

1. Structure information:


| | |
|--|--|
| Establishment name | |
| Type of structure | |
| Structure/Hangar reference | |
| Location of structure | |
| Date of last Condition Inspection (CI) | |

2. Emergency Action Plan (Refer to TB 99/29)

| | |
|---|----------|
| 2.1 Is an Emergency Action Plan in place? | (Yes/No) |
|---|----------|

3. Condition Summary

| | |
|---|--|
| 3.1 THE STRUCTURE: | |
| 3.1a Defects which do NOT make the structure UNSAFE: | |
| 3.1b Defects which make the structure UNSAFE: | |
| 3.2 FIXED ACCESS SYSTEMS AND ANCHORAGE POINTS | |
| 3.2a Defects which do NOT make the fixed access systems or anchorage points UNSAFE: | |
| 3.2b Defects which make the fixed access systems or anchorage points UNSAFE: | |
| 3.3 DOORS and SUPPORTS | |
| 3.3a Defects which do NOT make the doors or supports UNSAFE: | |
| 3.3b Defects which make the doors or supports UNSAFE: | |

| | | |
|--|--|-------------------------|
| DEFENCE INFRASTRUCTURE ORGANISATION  | HANGAR STRUCTURE CONDITION INSPECTION CONDITION CERTIFICATE (Page 2 of 2) | R104 Aug 2011 |
|--|--|-------------------------|

4. Recommended Works


| | |
|--|----------|
| Do the completed works comply with agreed design and drawings? | (Yes/No) |
| New Structure <input type="checkbox"/> or, Refurbished/Remedial Works <input type="checkbox"/> (Tick one box) Brief description of works: | |

5. Certificate Validity

| | |
|---|--|
| This Certificate remains extant until the date stated in the box unless superseded before by a replacement certificate (dd/mm/yy) | |
|---|--|

6. Certified by:

| | |
|----------------------------------|--|
| Name of Inspector | |
| Professional Qualification(s) | |
| Organisation (name & address) | |
| Signature | |
| Date | |

| | | | |
|--|---|---|---|
| DEFENCE INFRASTRUCTURE ORGANISATION |  | <p align="center"> HANGAR STRUCTURE CONDITION INSPECTION SUMMARY REPORT (Page 1 of 2) </p> | <p align="center"> R105 Aug 2011 </p> |
|--|---|---|---|

Structure information:


| | |
|----------------------------|--|
| Establishment name | |
| Type of structure | |
| Structure/Hangar reference | |
| Location of structure | |

Summary of estimated work costs (see following page(s) for details):

| Description | Estimated cost (£) |
|--|--------------------|
| Priority 1 - Urgent repairs - required to make the structure safe | |
| Priority 2 - Routine repairs - required to remedy unsatisfactory defects | |
| Priority 3 - Preventative maintenance | |
| Total | |

Certified by:

| | |
|----------------------------------|--|
| Name of Inspector | |
| Professional Qualification(s) | |
| Organisation (name & address) | |
| Signature | |
| Date | |

| | | |
|--|---|-------------------------|
| DEFENCE INFRASTRUCTURE ORGANISATION  | HANGAR STRUCTURE CONDITION INSPECTION SUMMARY REPORT (Page 2 of 2) | R105 Aug 2011 |
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Priority 1 - Urgent repairs - required to make the structure safe

| Works Element | Description of defect | Estimated cost (£) |
|----------------------------|-----------------------|--------------------|
| | | |
| | | |
| | | |
| Total (carried to summary) | | |

Priority 2 - Routine repairs - required to remedy unsatisfactory defects

| Works Element | Description of defect | Estimated cost (£) |
|----------------------------|-----------------------|--------------------|
| | | |
| | | |
| | | |
| Total (carried to summary) | | |

Priority 3 - Preventative maintenance

| Works Element | Description of defect | Estimated cost (£) |
|----------------------------|-----------------------|--------------------|
| | | |
| | | |
| | | |
| Total (carried to summary) | | |