
**Performance guidelines for design
of concrete structures using fibre-
reinforced polymer (FRP) materials**

*Lignes directrices de performance pour la conception des structures
en béton utilisant des polymères renforcés de fibres (PRF)*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 14484:2013](https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013)

[https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-
2d46551c2082/iso-14484-2013](https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013)



iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 14484:2013

<https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2013

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

	Page
Foreword.....	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Design basics	2
4.1 General.....	2
4.2 Design methodology.....	2
5 Properties of materials	2
5.1 Properties of concrete and steel.....	2
5.2 Properties of FRP materials.....	2
5.3 Resins.....	3
6 Structural analysis	3
7 Serviceability limit states	3
7.1 General.....	3
7.2 Calculation of stress and strain.....	3
7.3 Cracking.....	4
7.4 Deflections.....	4
8 Ultimate limit states	4
8.1 General.....	4
8.2 Axial and flexural capacity.....	4
8.3 Shear capacity.....	5
9 General structural details	5
9.1 FRP reinforcements/tendons.....	5
9.2 Externally bonded FRP sheets/plates.....	6
9.3 Near-surface mounted FRP reinforcement.....	6

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 6, *Non-traditional reinforcing materials for concrete structures*.

ITEH STANDARD PREVIEW

(standards.iteh.ai)

[ISO 14484:2013](https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013)

<https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013>

Introduction

Continuous fibre-reinforced polymer (FRP) materials are being widely applied to concrete structures. FRP materials have many advantages, such as a high strength/weight ratio and immunity to corrosion. FRP materials are available in a variety of geometries, including rod, grid, plate, sheet, strand, etc.

ISO/TC 71/SC 6 was established to develop standards for non-traditional reinforcing materials such as FRP. This International Standard describes the general performance requirements for concrete structures with the use of FRP materials. It is an umbrella-type document with general provisions and guidelines and lists the regional consensus guidelines/standards that are deemed to satisfy this International Standard. The regional guidelines/standards are generally more prescriptive in nature and vary somewhat from region to region.

This International Standard should be intended to provide wide latitude in terms of general requirements for performance verification and assessment of concrete structures with the use of FRP materials. It should be used, therefore, in conjunction with sound engineering judgment.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 14484:2013](https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013)

<https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 14484:2013

<https://standards.iteh.ai/catalog/standards/sist/b488783f-7bc3-4546-8a53-2d46551c2082/iso-14484-2013>

Performance guidelines for design of concrete structures using fibre-reinforced polymer (FRP) materials

1 Scope

This International Standard provides general principles for the verification and assessment of the performance of concrete structures with the applications of different FRP systems varying from internal FRP reinforcements/tendons, external FRP tendons, externally bonded FRP sheets/plates, to near-surface mounted FRP reinforcement. It can be used for the international harmonization of the design of un-reinforced, conventionally reinforced, and pre-stressed concrete structures with the use of the above-mentioned FRP systems.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2394, *General principles on reliability for structures*

ISO 10406-1, *Fibre-reinforced polymer (FRP) reinforcement of concrete — Test methods — Part 1: FRP bars and grids*

ISO 10406-2, *Fibre-reinforced polymer (FRP) reinforcement of concrete — Test methods — Part 2: FRP sheets*

ISO 19338, *Performance and assessment requirements for design standards on structural concrete*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19338, ISO 10406-1, ISO 10406-2, and ISO 2394 and the following apply.

3.1

bonding

attachment between FRP and substrates

3.2

concrete substrate

concrete or any cementitious material used to repair or replace the original concrete

Note 1 to entry: The substrate can consist entirely of original concrete, entirely of repair materials, or of a combination of original concrete and repair materials.

3.3

debonding

separation at the interface between the substrate and the near-surface mounted or externally bonded FRP materials

3.4

FRP material

assembly of dissimilar materials with a polymeric matrix and continuous fibre reinforcement of aramid, carbon, glass, etc.

3.5

near-surface mounted (NSM) FRP reinforcement

FRP bar or strip which is bonded inside a groove near the surface of a structural component

3.6

FRP plate

single or multiple layers of fabric or mat reinforcement bound together in a resin matrix, precured prior to application

3.7

FRP sheet

dry, flexible component which consists of continuous fibres aligned in one or more directions and held together in-plane to create a ply of finite width and length, and is used in wet lay-up systems

4 Design basics

4.1 General

Design of concrete structures with FRP materials should consider safety, serviceability, and restorability during service life. Where applicable, limit states caused by fire, seismic actions, or other extreme loading or actions should be considered. In addition to the above, economy should also be considered.

Suitable analysis should be performed to verify that the performance requirements for concrete structures with FRP materials in terms of limit states such as serviceability limit states (SLS) and ultimate limit states (ULS) in accordance with ISO 2394:1998 are satisfied.

4.2 Design methodology

A design methodology for concrete structures with FRP materials should be based on quantitative performance evaluation at the limit states. A rational method should be adopted for analysing each limit state.

Design of concrete structures with FRP materials should consider the linear elastic material properties of FRP and the properties of bond, if available, between the FRP and concrete, based on quantitative performance evaluation at the ultimate limit states.

5 Properties of materials

5.1 Properties of concrete and steel

Properties of concrete and steel should be determined in accordance with those specified for general structural concrete in ISO 19338:2007.

In the case of upgrading existing concrete structures with FRP materials, the strengths of concrete and steel should be determined with consideration of the *in situ* conditions, such as measured material and geometric properties of the existing concrete structures, instead of their material strength values used in the original design.

5.2 Properties of FRP materials

5.2.1 General

The FRP materials used for concrete structures should be those whose quality and performance characteristics have been confirmed to be compatible with environmental conditions under which the structure will be exposed.

The characteristics of FRP materials should be defined in general conformance with reliability-based design requirements.

The compressive strength of FRP materials should not be considered for design.

If necessary, the temperature-sensitive characteristics of FRP materials should be appropriately considered in design, with attention to its possible strength and stiffness loss at elevated temperatures.

5.2.2 FRP bars, grids, and plates

Properties of FRP bars, grids, and plates should be determined in accordance with ISO 10406-1:2008.

5.2.3 FRP sheets

Properties of FRP sheets should be determined in accordance with ISO 10406-2:2008.

5.2.4 Other FRP systems

Properties of other types of FRP systems should be determined based on appropriate test methods, with consideration to their intended applications.

5.3 Resins

Mechanical and physical properties of resins (matrix for fibres and bonding adhesives) should be determined in accordance with appropriate standards, such as corresponding ISO technical standards.

6 Structural analysis

Structural analysis of concrete structures with FRP materials should consist of the determination of structural response for the examination of limit states such as ultimate limit states and serviceability limit states. In general, structural analysis methodologies specified in ISO 19338 for structural concrete with traditional reinforcing materials may be applied for concrete structures with FRP materials.

Structural analysis of concrete structures with FRP materials should take into account the linear elastic material properties of FRP and the possible debonding failure between the FRP and concrete, which limit development of ductility in the structure. In general, no moment redistribution should be considered unless otherwise specified.

7 Serviceability limit states

7.1 General

Serviceability limit states should be verified to ensure the intended performance of concrete structures with FRP materials under service conditions during their design life.

7.2 Calculation of stress and strain

Unless otherwise specified, linear analysis should be used in the computation of stresses and strains in FRP in member sections under service.

In the case of upgrading existing concrete structures using FRP materials, the initial stresses in the member sections due to the permanent loads existing before FRP upgrading should be appropriately considered for analysis.