
Simplified design for mechanical connections between precast concrete structural elements in buildings

*Conception simplifiée pour les assemblages mécaniques entre
éléments structurels en béton préfabriqué dans les bâtiments*





COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, 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
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Properties	3
5 Classification	4
5.1 General	4
5.2 Strength	4
5.3 Ductility	4
5.3.1 Ductile connections	4
5.4 Dissipation	5
5.5 Deformation	5
6 Floor-to-floor connections	5
6.1 Cast-in-situ topping	5
6.1.1 General	5
6.1.2 Strength	6
6.1.3 Other properties	6
6.2 Cast-in-situ joints	6
6.2.1 General	6
6.2.2 Strength	6
6.2.3 Other properties	7
6.3 Welded steel connectors	7
6.3.1 General	7
6.3.2 Strength	7
6.3.3 Other properties	10
6.4 Bolted steel connectors	10
6.4.1 General	10
6.4.2 Strength	10
6.4.3 Other properties	13
7 Floor-to-beam connections	14
7.1 Cast-in-situ joints	14
7.1.1 General	14
7.1.2 Other properties	14
7.2 Supports with steel angles	14
7.2.1 General	14
7.2.2 Strength	16
7.2.3 Ductility	22
7.2.4 Dissipation	22
7.2.5 Deformation	23
7.2.6 Cyclic decay	23
7.2.7 Damage	23
7.3 Supports with steel shoes	23
7.3.1 General	23
7.3.2 Strength	23
7.3.3 Ductility	30
7.3.4 Dissipation	30
7.3.5 Deformation	30
7.3.6 Cyclic decay	30
7.3.7 Damage	30
7.4 Welded supports	30
7.4.1 General	30

	7.4.2	Strength	31
	7.4.3	Other properties	33
7.5	Hybrid connections		34
	7.5.1	General	34
	7.5.2	Strength	34
	7.5.3	Other properties	37
8	Beam-to-column connections		37
8.1	Cast-in-situ joints		38
	8.1.1	General	38
	8.1.2	Strength	39
	8.1.3	Ductility	41
	8.1.4	Dissipation	42
	8.1.5	Deformation	42
	8.1.6	Cyclic decay	42
	8.1.7	Damage	42
8.2	Dowel connections		42
	8.2.1	General	42
	8.2.2	Strength	43
	8.2.3	Ductility	49
	8.2.4	Dissipation	49
	8.2.5	Deformation	49
	8.2.6	Cyclic decay	49
	8.2.7	Damage	50
8.3	Mechanical coupler connections		50
	8.3.1	General	50
	8.3.2	Strength	51
	8.3.3	Ductility	52
	8.3.4	Dissipation	52
	8.3.5	Deformation	52
	8.3.6	Cyclic decay	52
	8.3.7	Damage	52
8.4	Hybrid connections		53
	8.4.1	General	53
	8.4.2	Strength	53
	8.4.3	Ductility	56
	8.4.4	Dissipation	56
	8.4.5	Deformation	57
	8.4.6	Cyclic decay	57
	8.4.7	Damage	57
9	Column-to-foundation connections		57
9.1	Pocket foundations		57
	9.1.1	General	57
	9.1.2	Strength	57
	9.1.3	Other properties	58
9.2	Foundations for columns with protruding bars		58
	9.2.1	General	58
	9.2.2	Strength	59
	9.2.3	Ductility	61
	9.2.4	Dissipation	61
	9.2.5	Deformation	61
	9.2.6	Cyclic decay	61
	9.2.7	Damage	61
9.3	Foundations with bolted sockets		62
	9.3.1	General	62
	9.3.2	Strength	63
	9.3.3	Ductility	65
	9.3.4	Dissipation	66

9.3.5	Deformation.....	66
9.3.6	Cyclic decay.....	66
9.3.7	Damage.....	66
9.4	Foundations with bolted flanges.....	67
9.4.1	General.....	67
9.4.2	Strength.....	67
9.4.3	Other properties.....	68
9.5	Foundations with mechanical couplers.....	68
9.5.1	General.....	68
9.5.2	Strength.....	68
9.5.3	Ductility.....	69
9.5.4	Dissipation.....	70
9.5.5	Deformation.....	70
9.5.6	Cyclic decay.....	70
9.5.7	Damage.....	70
10	Calculation of actions.....	70
10.1	General criteria.....	70
10.2	Capacity design.....	70

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 (see 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 (see 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.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 5, *Simplified design standard for concrete structures*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document contains a set of practical provisions for the design of the mechanical connections in precast elements under seismic actions. Design of the connections is carried out in terms of strength verifications. Indications are also provided for defining the actions to be used in design.

If national standards provide alternate formulae for the same typology, those can be used instead of the ones given in this document.

Simplified design for mechanical connections between precast concrete structural elements in buildings

1 Scope

This document refers to connections in precast frame systems, either for single-storey or multi-storey buildings. The connections for all orders of joints are considered. Large wall panel and three-dimensional cell systems are not considered.

According to the position in the overall construction and of the consequent different structural functions, the seven following orders of joints are considered:

- a) *mutual joints between floor or roof elements* (floor-to-floor) that, in the seismic behaviour of the structural system, concern the diaphragm action of the floor;
- b) *joints between floor or roof elements and supporting beams* (floor-to-beam) that give the peripheral constraints to the floor diaphragm in its seismic behaviour;
- c) *joints between beam and column* (beam-to-column) that ensure in any direction the required degree of restraint in the frame system;
- d) *joints between column segments* (column-to-column) used for multi-storey buildings usually for dual wall braced systems;
- e) *joints between column and foundation* (column-to-foundation), able to ensure in any plane a fixed full support of the column;
- f) *fastenings of cladding panels to the structure* (panel-to-structure) that ensure the stability of the panels under the high forces or the large drifts expected under seismic action;
- g) *joints between adjacent cladding panels* (panel-to-panel) possibly used to increase the stiffness of the peripheral wall system and provide an additional source of energy dissipation.

Simple bearings working by gravity load friction are not considered. Sliding and elastic deformable supporting devices neither, being all these types of connections not suitable for the transmission of seismic actions.

The document provides formulae for the strength design of a large number of joint typologies.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

union

generic linking constraint between two or more members