INTERNATIONAL STANDARD

ISO 22502

First edition
2020-08

Simplified design of connections of concrete claddings to concrete structures

Reference number
ISO 22502:2020(E)

Contents

Page

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 prestressed 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

The current design practice of reinforced concrete buildings, most commonly precast, is based on a frame model, where the peripheral cladding panels enter only as masses without any stiffness. The panels are then connected to the structure with fastenings dimensioned with a local calculation based on their mass for anchorage forces orthogonal to the plane of the panels.

Furthermore, the seismic force reduction in the type of reinforced concrete structures of concern relies on energy dissipation in plastic hinges formed in the columns. Very large drifts of the columns are needed to activate this energy dissipation foreseen in design. However, typically, the capacity of the connections between cladding and structure is exhausted well before such large drifts can develop. Therefore, the design of these connections cannot rely on the seismic reduction factor typically used for design of the bare structure.

This document contains a set of practical provisions for the design of mechanical connections of concrete claddings to concrete structures under seismic actions as well as suggestions for structural analysis for the specified systems.

Simplified design of connections of concrete claddings to concrete structures

1 Scope

The present document refers to the panel-to-structure and panel-to panel connections used for the cladding systems of reinforced concrete frame structures of single-storey buildings, typically precast. They can be used also for multi-storey buildings with proper modifications.

The fastening devices considered in the present document consist mainly of steel elements or sliding connectors. Dissipative devices with friction or plastic behaviour are also considered. Other types of common supports and bond connections are treated where needed.

The use of any other existing fastening types or the connections with different characteristics than those described in the following clauses is not allowed unless comparable experimental and analytical studies do provide the necessary data and verify the design methodology for the particular type.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 20987, *Simplified design for mechanical connections between precast concrete structural elements in buildings*

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
behaviour factor *q*
q factor by which the elastic design spectrum in linear analysis is reduced

Note 1 to entry: Directly or indirectly linked to the ductility and deformation demands on members and connections.

4 Generalities

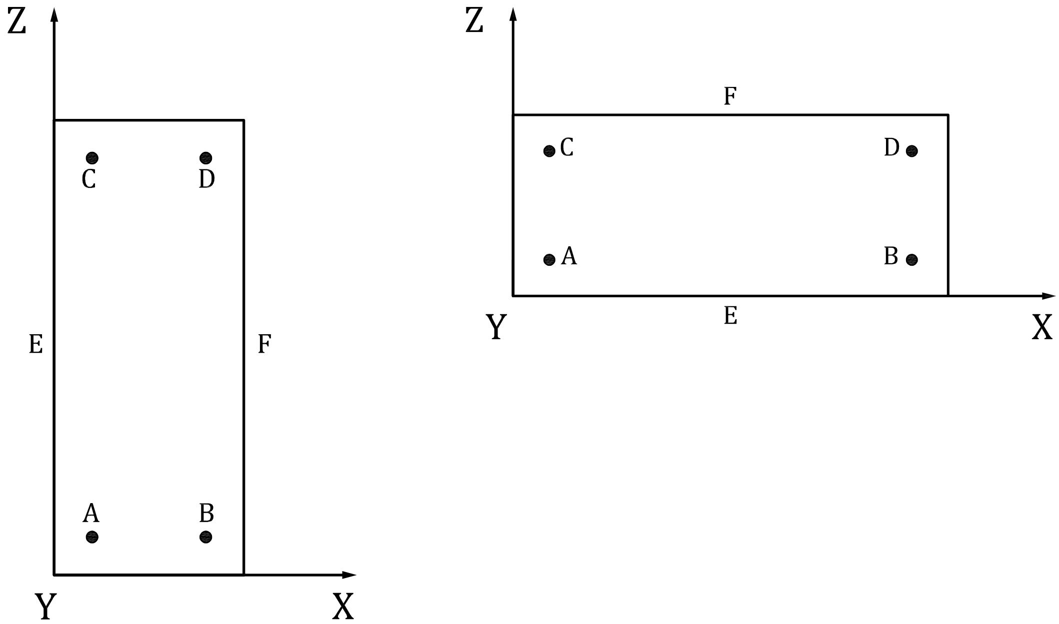
4.1 Cladding panel orientations

Figure 1 a) shows a vertical panel orientation referred to a system of orthogonal axes, where x is oriented horizontally in the panel plane, y is oriented orthogonally to that plane and z is oriented vertically parallel to the gravity loads. The origin is placed in a corner at the base side of the panel.

Four connections are foreseen at the corners of the panel, indicated respectively by A, B, C and D. Any one of these connections is intended to give only translational restraints without any rotational restraint. E and F indicate the possible joint connections with the adjacent panels. Usually, the connections A and B are attached to the foundation beam, the connections C and D are attached to the top beam.

The couple of bottom and top connections may be replaced by single connections placed in the middle of the bottom and top sides for a pendulum arrangement of the panel. In this case, the connections are respectively named A and C, and the symbols B and D are omitted.

In Figure 1 b), the same reference system is associated with a horizontal panel for which the connections A, B, C and D are usually attached to the columns, and E and F refer to the possible joint connections with the adjacent panels, foundation or top beam where the uncertain friction effect can act due to the superimposed panels.



a) Vertical **b) Horizontal**

Figure 1 — Cladding panel orientations

Table 1 — Symbols and graphic schemes for supports

Symbol	Description	Graphic scheme
f	fixed (bilateral)	▼ ►◄,▲
f+	fixed (unilateral in + direction)	▲, ►
f-	fixed (unilateral in - direction)	▼, ◄
s	sliding (bilateral)	↔, ↕
d	dissipative	ΛΛΛ
/	omitted	[empty]

Table 1 gives a general description of the symbols and graphic schemes regarding the effect of the supports along the three directions x, y and z. As an example, Table 2 gives the arrangement matrix indicating the effect of the supports for a vertical panel.

Table 2 — Arrangement matrix – example

Direction	A	B	C	D	E	F
x	f	/	s	/	f	f
y	f	/	f	/	/	/
z	f	/	/	/	d	d

The term “fixed” is used with reference to the restrained linear displacement while the rotational restraints are not provided.

4.2 Design criteria to connect frame and panels

4.2.1 Isostatic approach

An isostatic arrangement of panel connections is able to allow without reactions the large displacements expected for the frame structure under earthquake conditions. Very large displacement capacities are required for connectors with this choice.

The frame deformation demand is allowed by a relative clearance that uncouples the motion of frame and panels. The two systems are kinematically uncoupled, except for the out-of-plane displacements [see Figure 2 a)].

4.2.2 Integrated approach

An integrated arrangement relies on fixed connections that integrate the panels in the resistant structural assembly with a dual wall-frame system behaviour. High forces may arise in the connections with this choice.

Panels and frame have a coupled motion: the system is kinematically paired [see Figure 2 b)]. Panels become part of the seismic resisting system and they act as the main restraints in the horizontal direction thanks to their higher stiffness. As a consequence, the connections shall be over-proportioned to carry the higher loads transferred by the frame, according to capacity design rules.

4.2.3 Dissipative approach

An arrangement of dissipative connections between the panels is added to an isostatic system of fastenings to the structure, able to maintain displacements and forces within lower predetermined limits.

Specific devices can balance the overall building response, reducing the displacement and keeping the load below an imposed threshold, determined by the connections themselves [see Figure 2 c)]. Like in the isostatic configuration, the systems are kinematically uncoupled but they are also constrained by inelastic links, like friction or yielding devices. The joints between structure and panels – or among the panels – shall be designed to dissipate energy during the seismic action.