भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG, NEW DELHI 110002

व्यापक परिचालन मसौदा

हमारा संदर्भः सीईडी13 /टी-14 **11 फ़रवरी 2025**

तकनीकी समिति: भवन निर्माण की रीतियॉं विषय समिति, सीईडी 13

प्राप्तकर्ता :

क) सिविल इंजीनियरी विभाग परिषद्, सीईडीसी के सभी सदस्य
ख) सीईडी 13 के सभी सदस्य
ग) रूचि रखने वाले अन्य निकाय

प्रिय महोदय/महोदया,

निम्नलिखित भारतीय मानक का मसौदा संलग्न है:

प्रलेख संख्या	शीर्षक
सीईडी13 (26769) WC	**ठोस निर्माण की दीवारों, छतों और फर्शों में उपकरण लगाना भाग 1 पोस्ट-इंस्टॉल किए गए एंकर के अलावा अन्य उपकरण — रीति संहिता का भारतीय मानक मसौदा** (आईएस 1946 का पहला पुनरीक्षण), ICS 91.190

कृपया इस मानक के मसौदे का अवलोकन करें और अपनी सम्मतियॉं यह बताते हुए भेजे कि यदि यह मानक के रूप में प्रकाशित हो तो इस पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या कठिनाइयाँ आ सकती हैं।

सम्मतियॉं भेजने की अंतिम तिथि : **11 मार्च 2025**

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यदि कोई सम्मति प्राप्त नही होती है अथवा सम्मति में केवल भाषा सम्बन्धी त्रुटि हुई तो उपरोक्त प्रलेख को यथावत अंतिम रूप दिया जाएगा। यदि सम्मित तकनीकी प्रकृति की हुई विषय समिति के अध्यक्ष के परामर्श से अथवा उनकी इच्छा पर आगे की कार्यवाही के लिए विषय समिति को भेजे जाने के बाद प्रलेख को अंतिम रूप दे दिया जाएगा।

यह प्रलेख भारतीय मानक ब्यूरो की वैबसाइट **www.bis.gov.in** पर भी उपलब्ध हैं।

धन्यवाद।

भवदीय,

(द्वैपायन भद्र)
प्रमुख (सिविल इंजीनियरी)

संगलन उपरिलिखित :

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG, NEW DELHI 110002

DRAFT IN WIDE CIRCULATION

Our Ref: CED 13/T-14 **11 February 2025**

TECHNICAL COMMITTEE: Building Construction Practices Sectional Committee, CED 13

ADDRESSED TO:

a) All Members of Civil Engineering Division Council, CEDC
b) All Members of CED 13
c) All others interests.

Dear Sir/Madam,

Please find enclosed the following document:

Doc No.	Title
CED 13(26769) WC	**Draft Indian Standard** **Fixing Devices In Walls, Ceilings And Floors Of Solid Construction Part 1 Devices Other Than Post-Installed Anchors – Code of Practice** (*First Revision* of IS 1946), ICS 91.190

Kindly examine the draft standard and forward your views stating any difficulties, which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for comments**: 11 March 2025**

Comments if any, may please be made in the attached format and mailed to the undersigned at the above address or preferably through e-mail to **ced13@bis.gov.in**.

In case no comments are received or comments received are of editorial nature, you may kindly permit us to presume your approval for the above document as finalized. However, in case of comments of technical in nature are received then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The document is also hosted on BIS website **www.bis.gov.in.**

Thanking you,

Yours faithfully,

(**Dwaipayan Bhadra**)
Head (Civil Engineering)

Encl: As above

FORMAT FOR SENDING COMMENTS ON BIS DOCUMENTS

(Please use A-4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/table/fig etc. be started on a fresh box. Information in column 3 should include reasons for the comments and suggestions for modified working of the clauses when the existing text is found not acceptable. Adherence to this format facilitates Secretariat's work) {Please e-mail your comments to **ced13@bis.gov.in**}.

Doc. No.: CED 13 (26769) WC

Title: Draft Indian Standard Fixing Devices in Walls, Ceilings and Floors of Solid Construction Part 1 Devices other than Post-Installed Anchors – Code of Practice (*First Revision* of IS 1946), ICS 91.190

LAST DATE OF COMENT: **11/03/2025**

NAME OF THE COMMENTATOR/ORGANIZATION: _____

Sl. No.	Clause/Para/Table/ Figure No. Commented	Comments/Modified Wordings	Justification of the Proposed Change

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

Draft Indian Standard

Fixing Devices in Walls, Ceilings and Floors of Solid Construction Part 1 Devices Other Than Post-Installed Anchors — Code of Practice

(*First Revision* of IS 1946)

ICS 91.190

Building Construction Practices Sectional Committee, CED 13	Last date of Comments **06 March 2025**

FOREWORD

(*Formal clauses will be added later*)

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Building Construction Practices Sectional Committee had been approved by the Civil Engineering Division Council.

IS 1946, the standard on “Fixing Devices in Walls, Ceilings and Floors of Solid Construction” was first published in 1961, and thereafter reaffirmed in 2002, 2012 and 2017. Later, the Committee decided to develop the standard in separate parts, to cover different types of fixing devices. Thus, IS 1946 is being developed in 5 different parts as follows:

Part 1 Devices other than Post-Installed Anchors - Code of Practice

Part 2 Design of Post-Installed Anchorage to Concrete - Code of Practice

Part 3 Testing and Assessment of Post-Installed Adhesive Anchoring Systems

Part 4 Testing and Assessment of Post-Installed Mechanical Anchoring Systems

Part 5 Post-Installed Anchorage to Concrete - Installation and on-site Inspection – Code of Practice

Fixing devices, such as cast-in place anchors, cast-in anchor channels, post-installed anchors, nails, for use in solid construction (concrete and masonry are of considerable usefulness in building work. The use of these fixing devices is becoming more common with the evolution of the construction industry and the practices.

Use of proper devices and trained installer will ensure a neat fixing work with minimum effort and little damage, and the fixtures will have adequate strength and durability. This standard attempts to provide the necessary guidance for their selection and fixing, also giving their essential dimensions and features, and situations of use.

Another specification on fixing devices for use in cavity construction and other base materials is under preparation.

In the formulation of this standard, assistance has been derived from

EN 1992-4:2018, Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete

This code is intended chiefly to lay down requirements regarding the different types of fixing devices commonly used in the industry and methods of installation, and it does not include all the necessary provisions of a contract.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

FIXING DEVICES IN WALLS, CEILINGS AND FLOORS OF SOLID CONSTRUCTION PART 1 DEVICES OTHER THAN POST-INSTALLED ANCHORS — CODE OF PRACTICE

(*First Revision of IS 1946*)

1 SCOPE

1.1 This standard lays down the essential features and methods of use of the following fixing devices:

a) cast-in place anchors,

b) cast-in anchor channels,

c) post-installed anchors and

d) nails

1.2 These fixing devices need to be suitable for use in walls, floors, and ceilings of solid construction (concrete – PCC/ RCC and masonry – brick/ AAC blocks)

NOTE – Any structural/critical connection should be avoided in AAC blocks.

2 REFERENCES

The standards (and documents) given in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on these standards are encouraged to investigate the possibility of applying the most recent editions of the standard given in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1946 (Part 2), IS 1946 (Part 3), IS 1946 (Part 4) and IS 800. In addition, the following terms shall apply.

3.1 Cast-in Place Anchor – Cast-in place anchors are built-in devices, as the name applies, that are embedded in concrete at the time of construction, and they may house a metallic thread for bolt fixtures.

3.2 Cast-in Anchor Channels – Cast-in anchor channels are pre-positioned cast-in fixing solutions, consisting of steel profile with rigidly connected anchors.

3.3 Channel Bolt – It is a bolt which connects the base plate or the element to be fixed to the cast-in anchor channel.

3.4 Concrete Blow-out Failure – This refers to failure of the concrete on the side face of the concrete member at the level of the embedded head of cast-in place anchor, with no major break-out at the top concrete surface.

3.5 Good for Construction Drawings – These are drawings prepared and approved by the concerned engineer-in-charge based on specifications and are crucial to construction industry's decision making process.

3.6 Manufacturer's Printed Installation Instruction – These are published instructions, provided by the manufacturer, for the correct installation of a fixing device under all covered installation conditions as supplied in the product packaging.

3.7 Nails – Nails are slender metal shaft that is pointed at one end and flattened at the other end and is used for fastening one or more objects to each other.

4 SYMBOLS AND NOTATIONS

For the purpose of this standard, the following letter symbols shall have the meaning indicated against each; where other symbols are used, they are explained at the appropriate place.

CIA – Cast-in place anchors;
CIC – Cast-in anchor channels;
GFC – Good for construction;
MPII – Manufacturer's printed installation instructions; and
PIA – Post-installed anchor.

5 PRINCIPLES OF FIXING

5.1 The fixing devices make use of tensile strength of concrete. Generally, they work on the principle of friction and keying, mechanical interlock, adhesive bonding, or a combination. For details on the working principles reference may be made to IS 1946 (Part 2).

5.2 Nails (specially the direct fastening nails) work on the principle of sintering and interlocking. When a nail is pushed into the concrete, it creates a space on the side by pushing the concrete and compacting it in the process. Intense heat generated during the process causes the concrete to be sintered onto the surface of the nail. The sintered concrete in the region of the fastening point forms ridges on the surface of the nail which helps in micro interlocking between the nail and the concrete.

5.3 For all installation instructions and guidance related to post-installed anchors in concrete, reference may be made to IS 1946 (Part 5)

5.4 The installation of fixing devices, other than post installed anchors, shall be undertaken by installers who have been adequately trained by the manufacturer to install the same. The installer shall produce a certificate of training issued by the manufacturer to the individual, having a validity of not more than one year. A certificate of completion must be provided by the installer after installation of the anchors stating that installation has been done as per MPII and submitted to the concerned engineer/ supervisor. A typical format is provided in Annex D.

6 APPLICATIONS

6.1 The fixing devices can be used for a wide range of applications – from light duty to heavy duty fixings. They can be used for temporary as well as for permanent fixing applications. A general guideline for selection of fixing devices for the most commonly observed applications is given in Table 1.

Table 1 General Guideline for Selection of Fixing Devices for Common Applications(*)
(*Clause* 6)

Sl No.	Application	Base Material	Type of Fixing Device
(1)	(2)	(3)	(4)
i)	Fixing of stadium seats	Concrete	CIA, CIC, PIA,
ii)	Fixing of elevator guide rails and divider beams	Concrete	CIA, CIC, PIA
iii)	Fixing of elevator guide rails and divider beams	Masonry	PIA

Sl No.	Application	Base Material	Type of Fixing Device
(1)	(2)	(3)	(4)
iv)	Fixing of equipment	Concrete	CIA, PIA
v)	Fixing of utility systems (cable trays, HVAC ducts, sprinkler pipes, etc.)	Concrete	CIA, CIC, PIA, Nails
vi)	Fixing of utility systems (cable trays, HVAC ducts, sprinkler pipes, etc.)	Masonry	PIA, Nails
vii)	Fixing of bracket for structural glazing, canopy, skylight, etc.	Concrete	CIA, CIC, PIA
viii)	Fixing of bracket for structural glazing, canopy, skylight, etc.	Masonry	PIA
ix)	Fixing of bracket for supporting crane beam	Concrete	CIA, PIA
x)	Fixing of bracket for mezzanine floor	Concrete	CIA, CIC, PIA
xi)	Fixing of bracket for mezzanine floor	Masonry	PIA
xii)	Fixing of noise barriers, crash barriers, OHE poles, light poles	Concrete	CIA, PIA
xiii)	Fixing of strut waler beams in underground structures	Concrete	CIA, CIC, PIA
xiv)	Fixing of railing and hand railing	Concrete/Masonry	CIC, PIA
xv)	Walkway fixing	Concrete	CIA, CIC, PIA
xvi)	Door and window frame fixing	Concrete/Masonry	PIA
xvii)	Dry Stone cladding	Concrete/Masonry	PIA (#)
xviii	Fixing of light weight fixtures like furniture, television, etc. directly to the wall	Concrete/Masonry	PIA
xix)	Prop fixing in precast structures	Concrete	PIA
xx)	Fixing of kicker-ring during TBM launch	Concrete	PIA
xxi)	Fixing of guide rail for TBM	Concrete	PIA

Sl No.	Application	Base Material	Type of Fixing Device
(1)	(2)	(3)	(4)
xxii)	Fixing of TBM retrieval shaft	Concrete	PIA
xxiii)	Fixing of lifting hook	Concrete	PIA
xxiv)	Fixing of Over Track Exhaust Fan, Tunnel Ventilation Fan, UPS Fan in tunnels	Concrete	PIA
xxv)	Fixing thin metal sheets: roof decking wall liners and floor decking	Concrete	Nails
xxvi)	Fixing thicker steel members e.g., metal brackets, clips	Concrete	Nails
xxvii)	Fixing soft materials such as wooden battens or insulation to concrete or masonry	Concrete/Masonry	Nails
xxviii)	Track fixing for dry walls	Concrete	PIA, Nails
xxix)	Connections for composite structures - Fixing nailed composite shear connectors	Concrete	PIA, Nails

NOTES

* The above table is only for guidance. It does not restrict the user from adoption of a particular system if technically acceptable. Essentially the fixing devices shall be selected such that they are able to withstand all possible load effects likely to act on them. For example, the fixing device used to suspend sprinkler pipes from the ceilings shall be adequate to withstand the self-weight of the pipes plus weight of water, hammering effect of the water during flow as well as earthquake forces transmitted to the sprinkler pipe support system during an earthquake event. The fixing devices used to connect a machine foundation shall be able to withstand dynamic effects due to operation of the machine.

For dry stone cladding, either the clamp has to be fixed to the concrete or masonry member through post-installed anchoring or the sub-frame is fixed to the base material (concrete or masonry) with the help of post-installed anchoring and clamps are connected to the sub-frame through welds or rivets.

7 SELECTION CRITERIA FOR FIXING AND EVALUATION OF CAPACITY

7.1 The selection of a fixing device shall be solely governed by the application type and criticality of the application. The performance of a fixing device is dependent on number of factors like the magnitude and the type of load (static, quasi static, dynamic, fire, fatigue, etc), the type of base material (like concrete, masonry), dimension of base material, grade of concrete, condition of the concrete (i.e., presence of concrete cracks), presence of adjacent fixing devices. They shall be verified and confirmed for adequacy taking into consideration all influencing factors. The resistance/ capacity shall be determined based on design, performed against all possible failure modes of steel and base material (i.e., concrete or masonry) and evaluated for group behavior for specific application conditions, in accordance with national standards or accepted engineering practices. For expansion plug anchor and nails, the data as per the technical data sheet of the manufacturer shall be used.

7.2 In general, the fixing devices shall be selected to suit the environmental/exposure conditions and required design service life of the structure. It is suggested to use a minimum of 5 micron galvanized fixing

device shall be used for dry internal condition and stainless steel (304 or 316 grade) or hot-dipped galvanized devices for other exposure conditions depending on the severity. For severity of exposure conditions, reference may be made to relevant national or equivalent international standards.

8 CAST-IN PLACE ANCHORS

8.1 General

These are the conventional types of fixing devices. Cast-in-place anchors are cast-in position in wet concrete before it sets. They are commonly referred to as cast-in bolts. Bolts with hexagonal head, hooked J bolts, L bolts etc. (*see* Fig.1) are some examples of cast-in-place anchors. They may house a metallic thread for bolt fixtures.

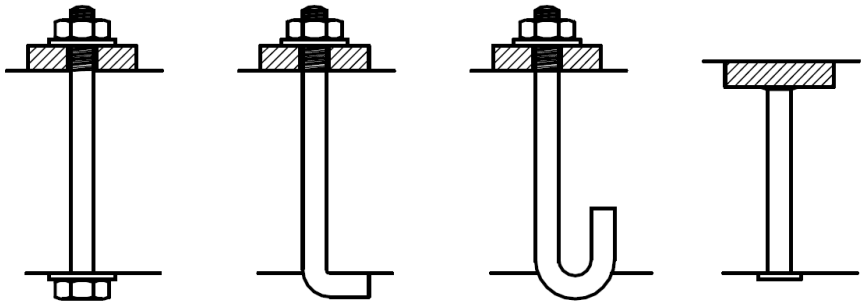


FIG. 1 CAST-IN PLACE ANCHORS

8.2 Requirement

The cast-in place anchors to be used shall be as per approved drawings by the concerned structural engineer. The parameters like grade of the bolt, anchorage depth, and diameter of the anchor, number and orientation shall be clearly specified in the GFC drawing based on analysis and design. The material specifications shall be as per the respective manufacturer; however, this should not contradict any provision of existing national standards. For design of cast-in place anchors, reference may be made to specialist literature. A preliminary guideline for design is provided in Annex B.

8.3 Method of Fixing

The manufacturer's printed installation instructions (MPII) should be followed. Some of the general steps are listed below (*see* Fig. 2):

a) Prior to fixing the anchors, a temporary wooden plate containing holes relevant to the diameter, location, and number of anchor bolts as per approved drawings is prepared;

b) The bolts are fixed to the temporary wooden plate accurately;

c) After survey work, the bottom part of the anchors shall be inserted inside the neck columns as per approved drawings;

d) After fixing the temporary wooden plates align, the anchors shall be levelled and fixed properly as per approved drawings;

e) The alignment and the level of the anchors have to checked after fixing; and

f) The Engineer-in-charge shall check the anchor bolts after fixing and post approval cover the anchors with masking tape protection before concreting.

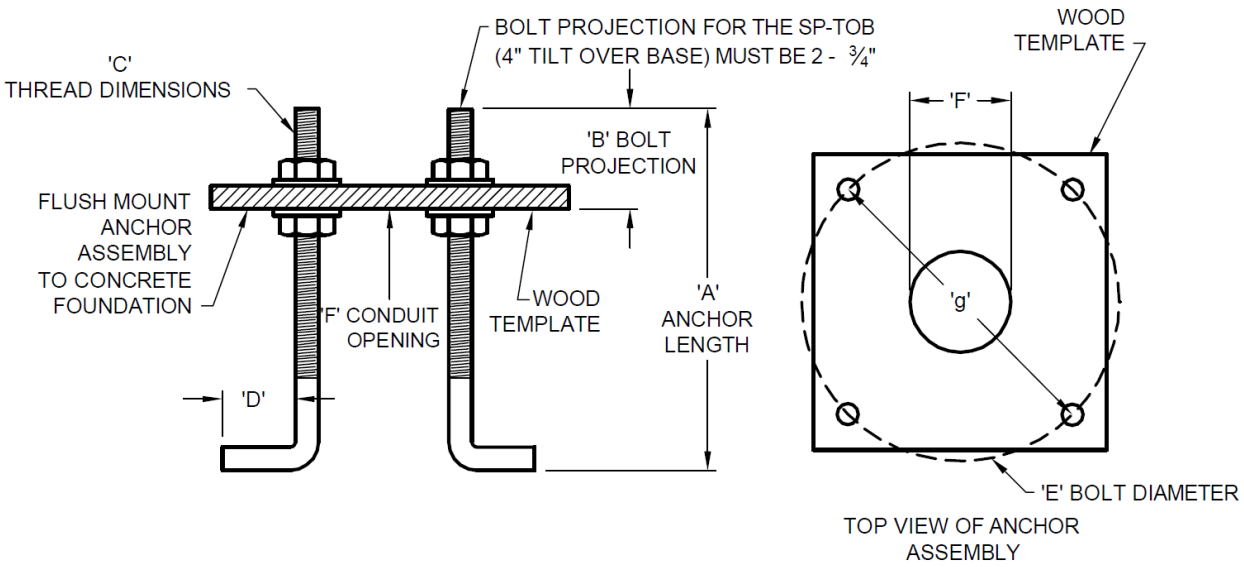


FIG. 2 METHOD OF FIXING OF CAST-IN PLACE ANCHORS

9 CAST-IN ANCHOR CHANNELS

9.1 General

These are innovative type of cast-in-place anchors. In this system, a channel is fitted with multiple headed anchor legs (two or more) (*see* Fig. 3). The headed anchor legs are either welded or screwed to the anchor channel. The anchor channel is usually square, rectangle or V-shaped. T-bolts fitted into the anchor channel serves as the fixing point. This fixing device offers multipoint anchoring system in a single assembly. Cast-in anchor channels can accommodate positioning tolerances in one direction. This fixing solution is commonly used where it is difficult to drill, for example - in high strength concrete, densely reinforced concrete, pre-stressed concrete etc.

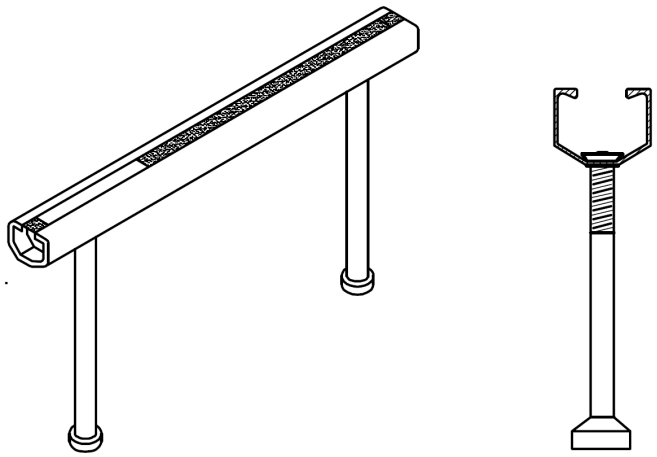


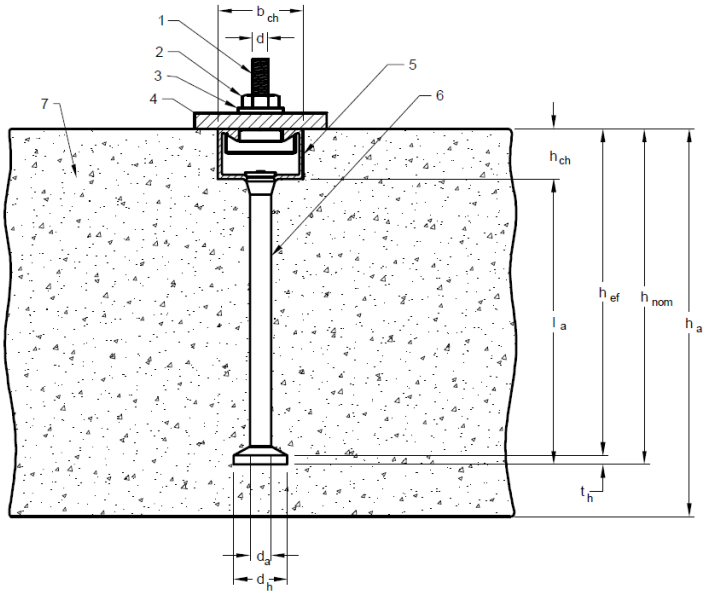
FIG. 3 CAST-IN ANCHOR CHANNELS

9.2 Requirement

The selection of the cast-in channel section shall be made based on the design requirement and recommendation by the concerned engineer-in charge. Dimensional requirements such as length of the channel, embedment depth, etc. shall be governed by the structural design and as per recommendation of

respective manufacturer. These details shall be clearly indicated in the GFC drawing. The material specifications shall be as per the respective manufacturer; however, this should not contradict any provision of existing standards (*see* Fig. 4). For design of cast-in anchor channels, reference may be made to specialist literature. A preliminary guideline for design is provided in Annex C.

A cast-in anchor channel consists of a channel profile with two lips and at least two metal anchors on the channel back. The anchors are fixed to the anchor channel at the manufacturing plant only and there can be as many anchors as desired that can be fastened to the anchor channel at constant spacing.



KEY
1 CHANNEL BOLT
2 HEXAGONAL BOLT
3 WASHER
4 FIXTURE
5 CHANNEL PROFILE
6 ANCHOR
7 CONCRETE MEMBERS

FIG. 4 DIMENSIONAL REQUIREMENT OF CAST-IN ANCHOR CHANNELS

9.3 Types

The cast-in anchor channel profiles, anchors and channel bolts are made of carbon steel (hot dipped galvanized) or stainless steel. Based on the manufacturing process, cast-in anchor channels can be classified as:

a) *Hot rolled section* – In this method the channels are heated and shaped above the recrystallization point of the metal. This leads to an increased diffusion and distribution of chemical components in the steel (*see* Fig. 5)

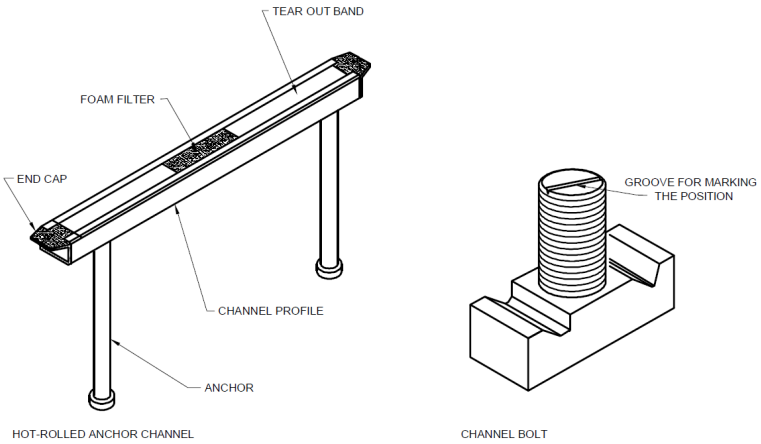


FIG. 5 HOT ROLLED CAST-IN ANCHOR CHANNELS

b) *Cold formed section* **–** In this method the metal sheet is folded under ambient temperature featuring constant thickness throughout the entire profile. This leads to low consumption of material and energy (*see* Fig. 6).

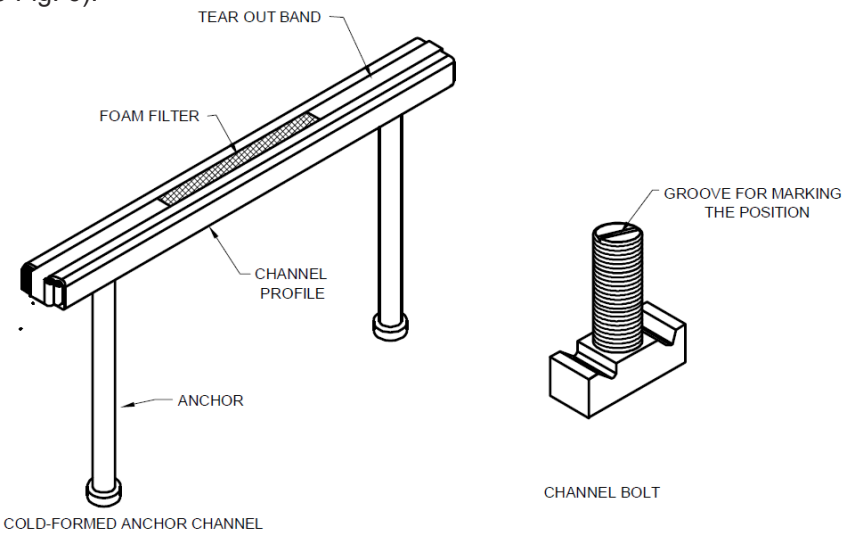


FIG. 6 COLD FORMED CAST-IN ANCHOR CHANNELS

c) *Temperature controlled roll shaping* (*TCRS*) **–** This is an innovative way of roll shaping. The metal sheet can be bent and straightened during the process. This process enables the production of geometries similar to hot rolled channels but with higher precision (*see* Fig. 7)

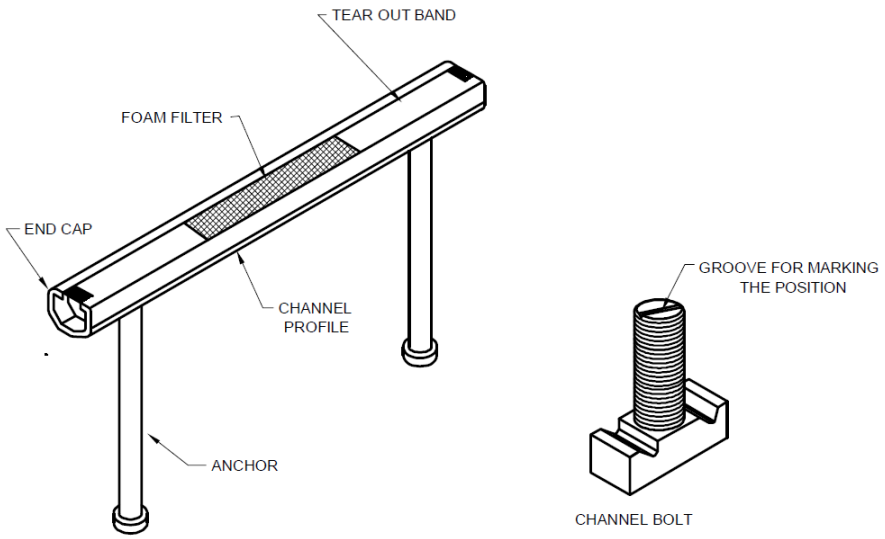


FIG. 7 TCRS CAST-IN ANCHOR CHANNELS

The cast-in anchor channels shall be verified and confirmed for adequacy against the appropriate load condition (static, seismic, fire, fatigue, etc.) basis the structural requirement, taking into consideration all influencing factors. They shall be designed against all possible failure modes of steel (which include the different elements like anchor, channel, connection between the anchor and the channel, the channel lip, etc.) and concrete.

9.4 Method of Fixing

MPII should be followed. Some of the general steps are listed below.

a) The anchor channel shall be selected based on design requirement and cut to the required length, if necessary, maintaining end spacing. Minimum two anchors shall be ensured per channel.

b) The anchor channels shall be positioned such that the channel lips will be flush with the surface of the concrete.

c) The anchor channels shall be secured to the formwork or adjoining reinforcing steel with nails, staples, rivets, or wire ties as appropriate.

d) Supports and attachments shall be adequate to ensure that anchor channels remain in position during concrete placement.

e) Anchor channels shall not be pushed into fresh concrete.

f) Anchors shall not be bent, cut, or otherwise modified.

g) The anchor channels shall be protected from intrusion of concrete and slurry into the channel during concrete placement.

h) The concrete around the anchor channels shall be compacted to mitigate voids.

j) The channels shall be leveled. The installed anchor channels shall be flush with the concrete surface.

k) The foam filler shall be removed after hardening of concrete and striking the formwork.

m) The channel bolt type shall be selected in accordance with the design specification.

n) Place the channel bolt in the channel and lock the channel bolt in the channel by turning it 90 degrees. The alignment of the bolt shall be verified with the groove. The channel bolt is not located outside of that portion of the channel bounded by the outermost anchors.

p) The channel bolts should not be cut.

q) The fixture shall be installed.

r) Right installation torque shall be applied to the channel bolt with a calibrated torque wrench.

The detailed installation instructions are provided in Fig. 8. The installation instruction for cast-in anchor channels is provided in Fig. 8(a) and the same for cast-in anchor channel bolts is indicated in Fig. 8(b)

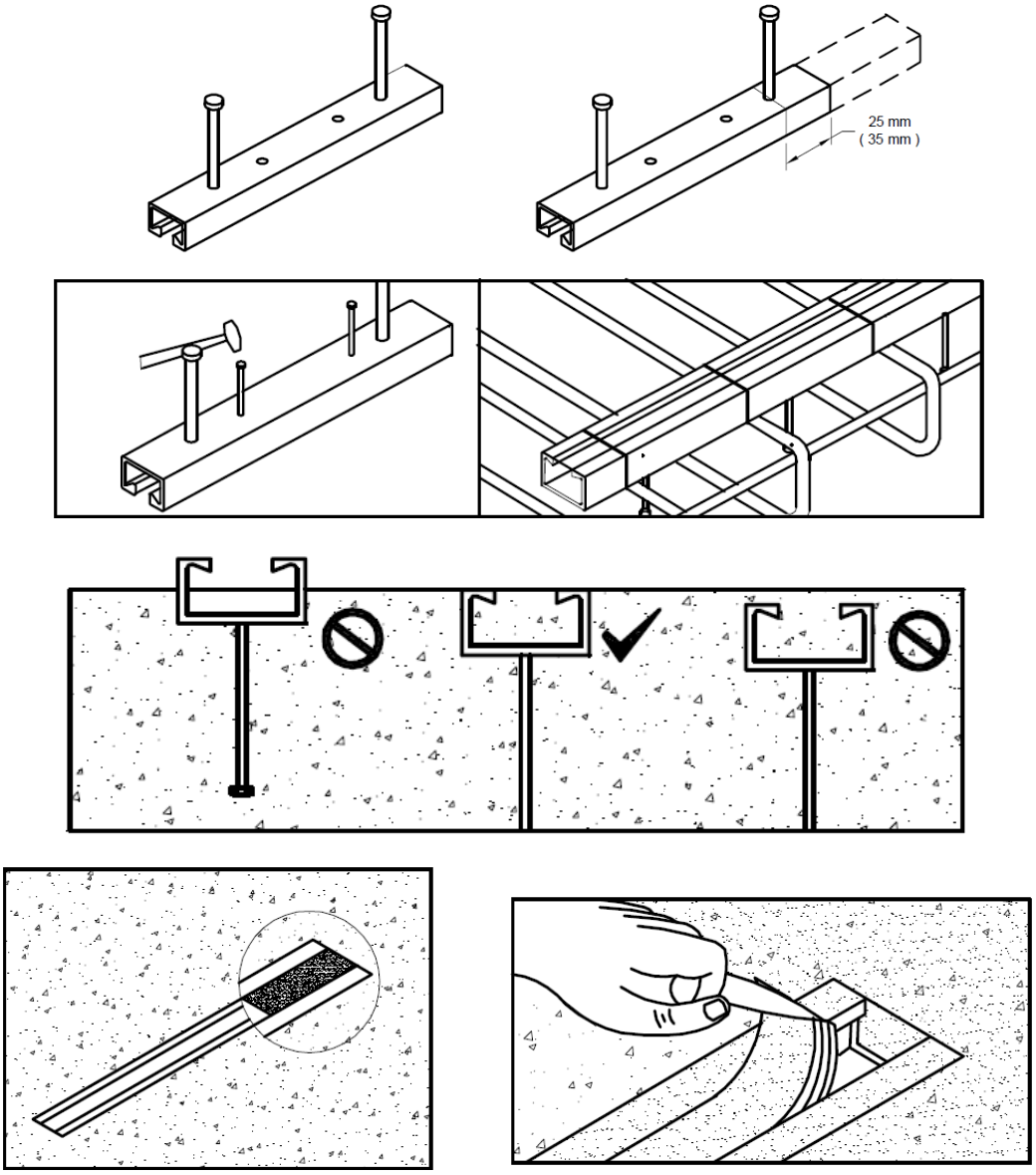


FIG. 8A INSTALLATION INSTRUCTIONS FOR CAST-IN ANCHOR CHANNELS

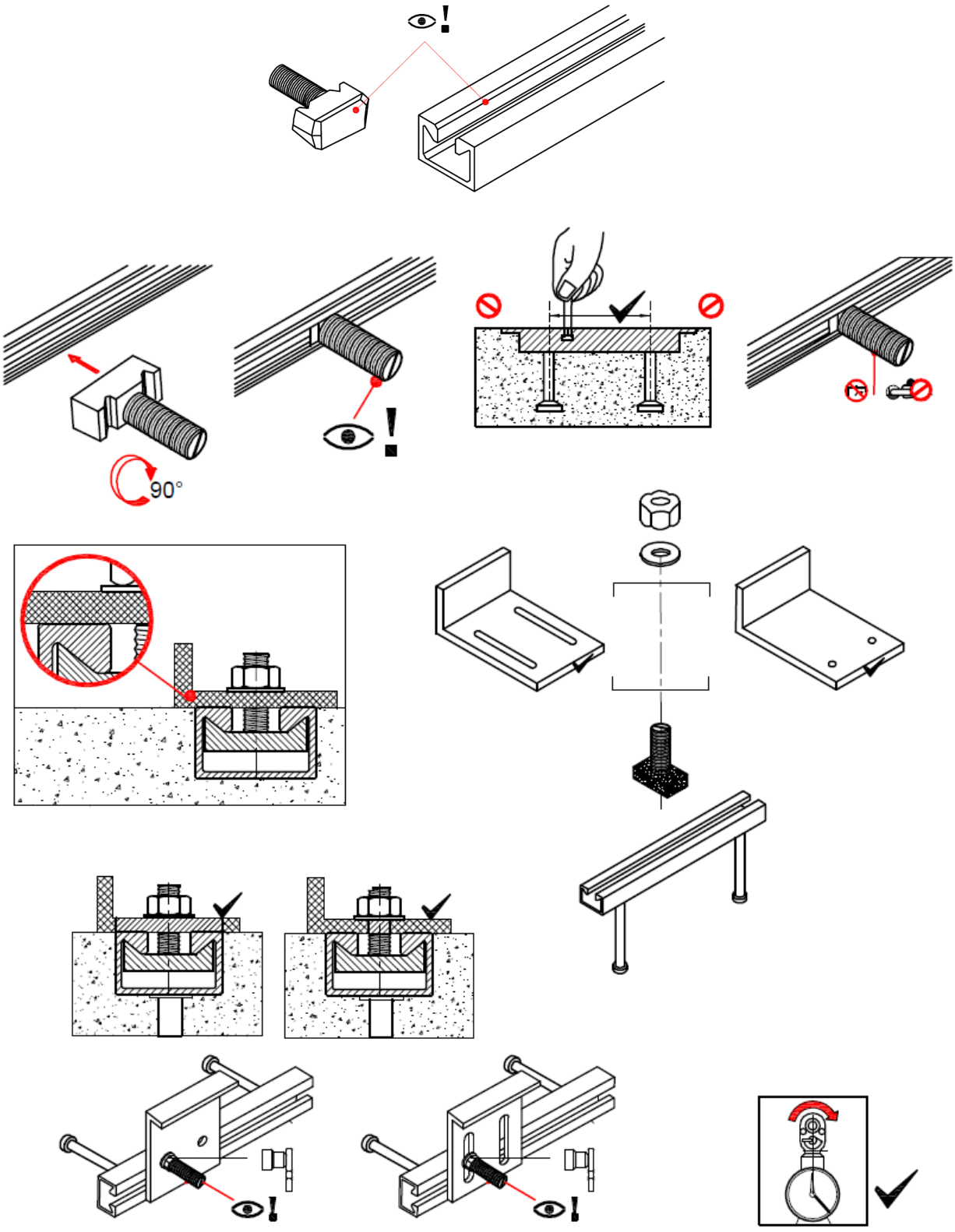


FIG. 8B INSTALLATION INSTRUCTIONS FOR CAST-IN ANCHOR CHANNEL BOLTS

FIG. 8 INSTALLATION INSTRUCTIONS FOR CAST-IN ANCHOR CHANNELS

10 POST-INSTALLED ANCHORS

10.1 General

Post-installed anchors are installed into hardened concrete or masonry and hence the name “post-installed”. This fixing technology requires a hole to be drilled the base material prior to installation of the anchor (see Fig. 9).

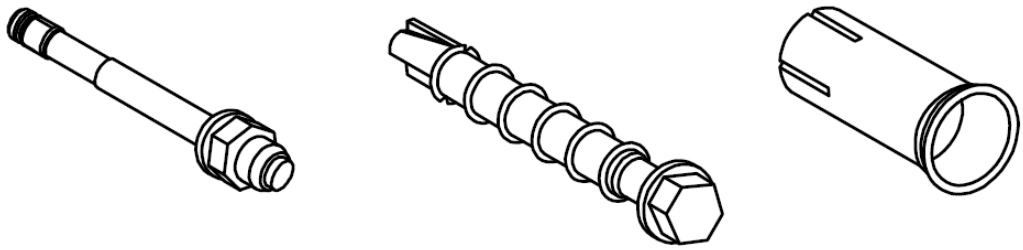


FIG. 9 POST-INSTALLED ANCHORS

10.2 Requirement

For design requirement of post-installed anchor in concrete, reference may be made to IS 1946 Part 2. For design of post-installed anchors in masonry, reference may be made to specialist literature.

10.3 Types

For details on different types of post-installed anchors in concrete, reference may be made to IS 1946 (Part 2) (*under development*).

Generally post-installed adhesive anchors, screws, and expansion plug anchors are recommended for use in masonry. However, other types of anchors, if tested and assessed for adequate performance in masonry, may also be used.

For details of expansion plug anchors, (*see* **11)**.

10.4 Method of Fixing –

10.4.1 For details on methods of fixing of post-installed anchors in concrete, reference may be made to IS 1946 Part 5 (*under development*)

10.4.2 For installation of post-installed adhesive anchors and screws in masonry, the general installation instructions are same as for post installed adhesive anchors and screws for concrete. For any specific recommendation, reference shall be made to MPII.

11 EXPANSION PLUG ANCHORS

11.1 General

Expansion wall plugs are hollow cylindrical sleeves inserted into a hole to which the fixture is attached by means of a screw. It holds the fixture by expanding and gripping tightly to the sides of the hole in which it is housed (*see* Fig. 10).

The expansion plugs or sleeves are generally made of polyamide or plastic. These are generally two way expansion or four way expansion sleeves. The screws can be galvanized, hot dipped galvanized or stainless steel depending on the application of the anchor.

The screws may have hexagonal head or countersunk heads depending on the application requirement. For example, for fixing of door frames, countersunk screws are required.

11.2 Requirement

The diameter and embedment depth of the plug shall be specified by the manufacturer and the overall length of the screw, or the anchor depends on the fastenable thickness or the fixture. The minimum diameter shall not be less than 6 mm.

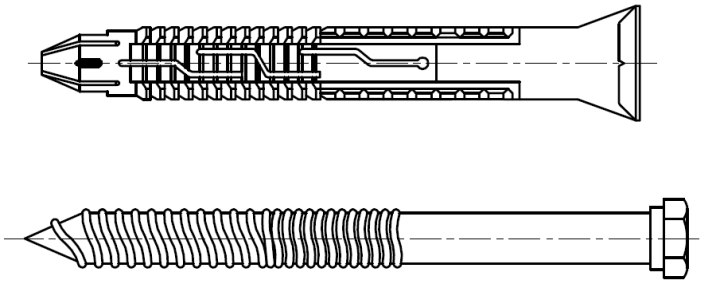


FIG. 10 EXPANSION PLUG ANCHORS

11.3 Method of Fixing

MPII should be followed. Some of the general steps are listed below.

a) The hole is to be drilled to the required embedment depth using a hammer drill machine with an appropriate carbide drill bit. The diameter of the drill hole shall be as per MPII.

b) Proper measures shall be taken to clean the hole.

c) The sleeve shall be installed in the hole.

d) The screw shall be fixed initially with hammering followed by the setting tool till full expansion of the sleeve is achieved.

The detailed installation instructions are provided in Fig. 11.

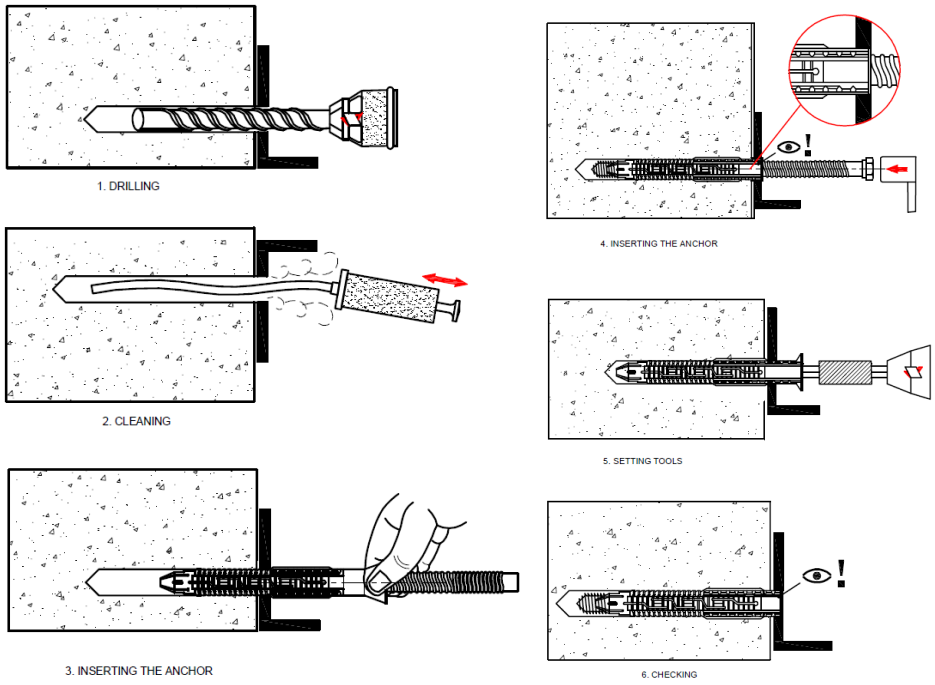


FIG. 11 INSTALLATION INSTRUCTION FOR EXPANSION PLUG ANCHORS

12 NAILS

12.1 General

These are driven directly into the base material. These fixing devices do not require drilling of hole in the base material prior to installation, in most applications. Conventionally they are hammered into base material.

The demand for quick installation and productivity has driven innovation in this segment as well leading to the development of tool based direct fastening technology. They may be broadly classified into – powder actuated fixing system, gas-actuated fixing system and battery powered fixing system (*see* Fig. 12)

In case of powder-actuated systems, the nail is driven using tool powered by propellant charge. Whereas gas powered tools are used for gas-actuated systems and battery powered tools are used for battery powered systems. This fixing technology is commonly used for light duty applications like wire mesh fixing, waterproofing membrane fixing etc.

(a) Regular concrete nails (a) Direct fastening nails

FIG. 12 NAILS

12.2 Types

12.3 Conventional Nails

For details on types and properties of concrete nails, reference to be made to IS 18741 ‘Concrete Nails – Specification’.

12.4 Method of Fixing

a) It is important to choose the right nail for the application.

b) Before driving nails, it is essential to prepare the surface to ensure a secure installation.

c) The surface shall be cleaned from any dirt, dust, or debris that could affect the nail's penetration.

d) If the nailing is being done into concrete, a hammer drill with a masonry bit shall be used to create pilot holes for the nails. The diameter of the pilot hole should be slightly smaller than the nail's diameter to provide a tight fit.

e) The nail shall be held in position, aligning it with the pilot hole or the desired location on the surface.

f) A hammer shall be used to start driving the nail into the surface, ensuring it is straight and perpendicular to the surface.

g) Using a hammer, the nail shall be driven into the surface with firm and consistent blows.

h) The depth shall be periodically checked to ensure it reaches the desired depth without penetrating too far or coming short.

12.5 Direct Fastening

Direct fastening technology is a technique in which specially hardened nails or studs are driven into concrete, or masonry by a piston-type tool. Materials suitable for fixing by this method are steel, wood, insulation, and some kinds of plastic. Nail driving power is generated by a power load (a cartridge containing combustible propellant powder, also known as a "booster"), combustible gas or by a battery. During the driving process, base material is displaced and not removed. The nails can be made of carbon steel or stainless steel.

NOTE – Regulations for use of powder actuated fasteners in India shall be adhered to.

For positioning and guiding during the driving operation, additional plastic or metal washer may be used.

The parts of the nails shall be specified by the manufacturer with reference to dimensions (diameter, thread length, etc.) and mechanical properties (core and surface hardness and zinc plating) including possible tolerance.

The nails can be classified in three general types: nails, threaded studs, and composite nails (*see* Fig. 13)

The nails used (also known as drive pins) are of a special type equipped with washers to meet the needs of the application and to provide guidance when driven.

Threaded studs are essentially nails with a threaded upper section instead of a head.

Composite nails are an assembly consisting of a nail with an application-specific fixing component such as a clip, plate or disk made of metal or plastic. Siding and decking nails can be recognized by their washers which are specially designed to hold down the metal sheets and to absorb excess driving energy.

Nails and threaded studs are commonly zinc-plated for resistance to corrosion during transport, storage and construction. As this degree of protection is inadequate for long-term resistance to corrosion, use of these zinc-plated nails is limited to applications where they are not exposed to the weather or a corrosive atmosphere during their service life.

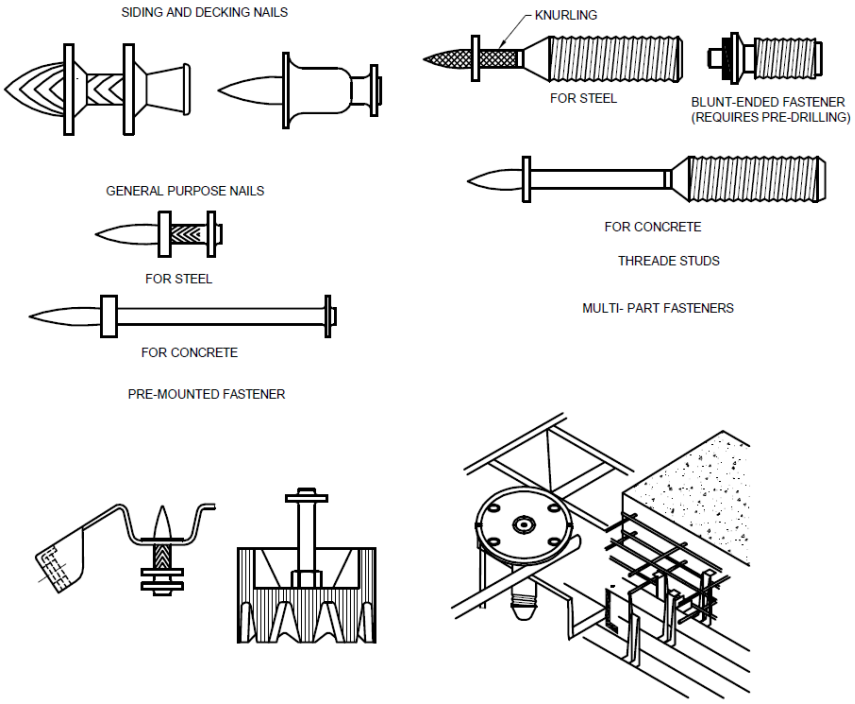


FIG. 13 TYPES OF DIRECT FASTENING NAILS

12.6 Method of Fixing

A power actuated fixing tool shall be used in order to install the nails. The driving force of the fixing tool is provided by power load of the cartridge in case of powder actuated tools, expanding gases in case of gas driven tools or electrical energy provided by battery for a battery driven tool. For proper installation of the nails, necessary tools as per the manufacturer shall be used and instructions as per MPII shall be strictly followed (*see* Fig. 14)

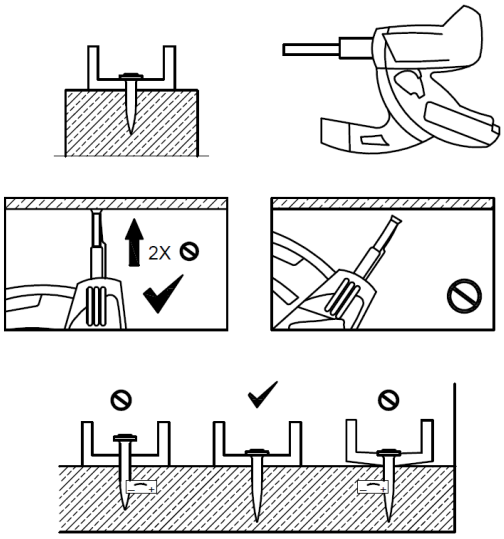


FIG. 14 INSTALLATION INSTRUCTIONS FOR POWER ACTUATED NAILS

13 INSPECTION AND CERTIFICATION OF INSTALLED DEVICES

Installation of fixing devices shall be supervised by an authorized member of the site management team, who is appropriately qualified.

For recommendation on inspection and certification of post-installed anchors, guideline are being developed in IS 1946 Part 5 (*under development*).

Similar provisions may be followed for other fixing devices as well.

14 PROOF TESTING OF FIXING DEVICES

Wherever proof testing is required after the installation of fixing devices to validate the quality of workmanship, the same may be done in accordance with IS 1946 Part 5.

ANNEX A
(*Clause* 2)

LIST OF CROSS REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 456 : 2000	Plain and reinforced concrete - Code of practice (fourth revision)
IS 800 : 2007	General construction in steel – Code of practice (*third revision*)
IS 875	Code of practice for design loads (other than earthquake) for buildings and structures:
(Part 1) : 1987	Dead loads — Unit weights of building materials and stored materials (*second revision*)
(Part 2) : 1987	Imposed loads (*second revision*)
(Part 3) : 2015	Design loads (other than earthquake) for buildings and structures — Code of practice: Part 3 Wind loads (*third revision*)
(Part 4) : 2021	Design loads (other than earthquake) for buildings and structures — Code of practice: Part 4 Snow loads (*third revision*)
(Part 5) : 1987	Code of practice for design loads (other than earthquake) for buildings and structures: Part 5 Special loads and load combinations (*second revision*)
IS 1367 :	Technical Supply Conditions for Threaded Steel Fasteners
IS 1608 (Part 1) : 2022 / ISO 6892-1 : 2019	Metallic materials - Tensile testing - Part 1 : Method of test at room temperature (*fifth revision*)
IS 1893 (Part1) :2016	Criteria for earthquake resistant design of structures (*sixth revision*)
IS 1946	Fixing Devices In Walls, Ceilings And Floors Of Solid Construction:
(Part 2) :202X	Design of post-installed anchorage to concrete - Code of practice *(under development)*
(Part 3) : 202x	Testing and Assessment of Post-Installed Adhesive Anchoring Systems *(under development)*
(Part 4) : 202x	Testing and Assessment of Post-Installed Mechanical Anchoring Systems *(under development)*
(Part 5) : 202x	Post-Installed Anchorage to Concrete -Installation and On-site Inspection — Code of Practice *(under development)*
IS 16700 : 2023	Criteria for structural safety of tall concrete buildings
IS 18741 : 2024	Concrete Nails - Specification

ANNEX B
(*Clause* 8.2)

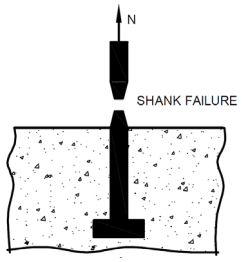
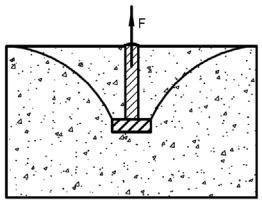
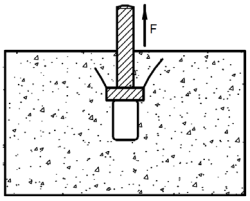
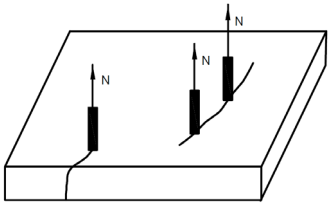
OVERVIEW OF DESIGN OF CAST-IN PLACE ANCHORS

B-1 The annexure provides a brief overview of the parameters to be checked for design of cast-in place anchors.

B-2 The resistance for individual failure modes in tension (*see* Table 2) and shear (*see* Table 3) shall be verified separately for adequacy and the minimum shall govern.

B-3 In case of both tension and shear loads acting simultaneously, additionally an interaction check shall be performed.

Table 2 Verification in tension for cast-in place bolts
(*Clause* 8.2, B-2)

Sl. No	Failure mode	Details
(i)	Steel failure of anchor	
(ii)	Concrete cone	
(iii)	Pull-out	
(iv)	Concrete splitting	

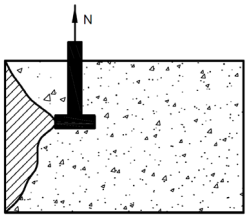
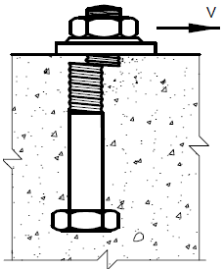
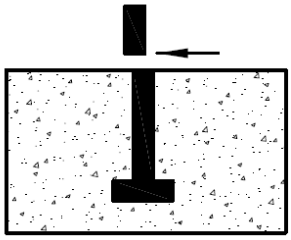
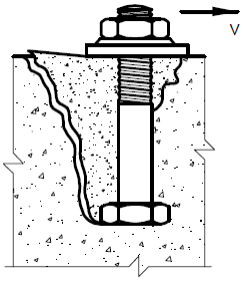
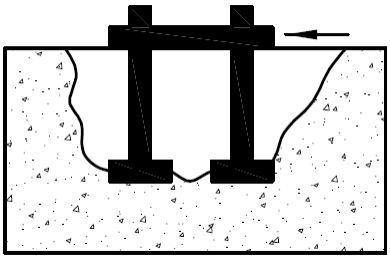
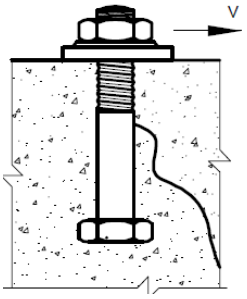
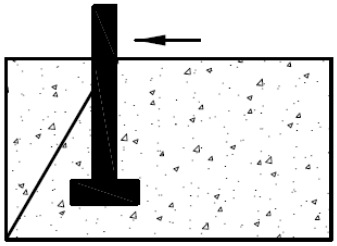
Sl. No	Failure mode	Details
(v)	Concrete blow-out	

Table 3 Verification in shear for cast-in place bolts
(*Clause* 8.2, B-2)

Sl. No.	Failure mode	Details
(i)	Steel failure of anchor	 
(ii)	Concrete pry-out failure	 
(iii)	Concrete Edge failure	 

ANNEX C
(*Clause* 9.2)

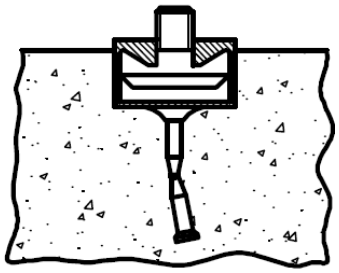
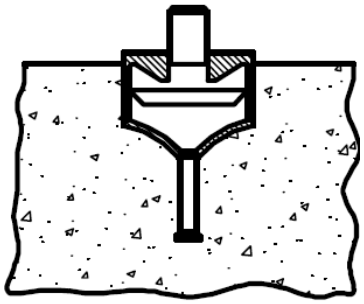
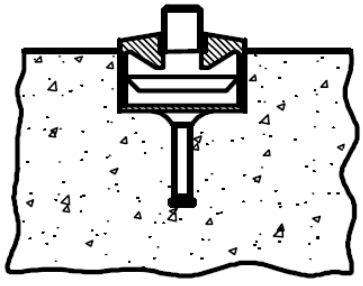
OVERVIEW OF DESIGN OF CAST-IN ANCHOR CHANNELS

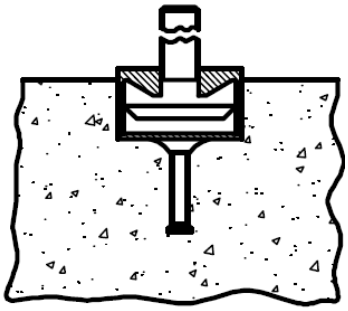
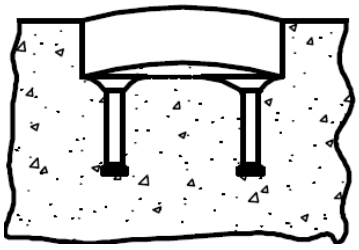
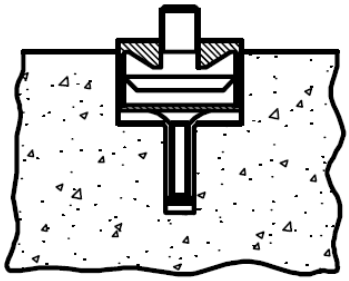
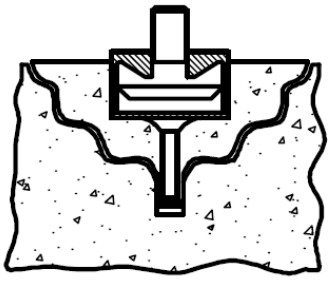
C-1 The annexure provides a brief overview of the parameters to be checked for design of cast-in channels.

C-2 The resistance for individual failure modes in tension (*see* Table 4)and shear (*see* Table 5)shall be verified separately for adequacy and the minimum shall govern.

C-3 In case of both tension and shear loads acting simultaneously, additionally an interaction check shall be performed.

Table 4 Verification in tension for cast-in anchor channels
(*Clause* 9.2, C-2)

Sl. No.	Failure mode	Details
(i)	Anchor	
(ii)	Connection between anchor and channel	
(iii)	Local flexure of channel lip	

Sl. No.	Failure mode	Details
(iv)	Channel bolt	
(v)	Flexure of channel	
(vi)	Pull-out failure	
(vii)	Concrete cone failure	

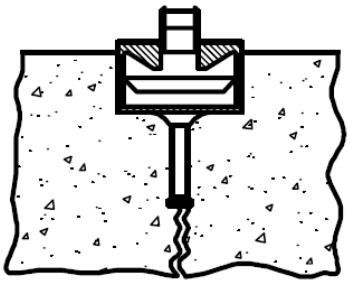
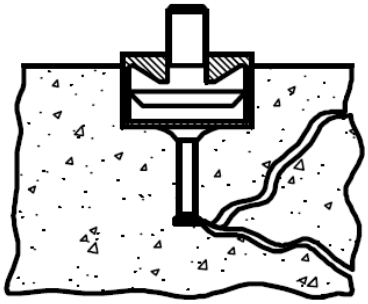
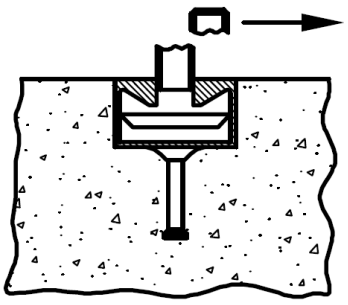
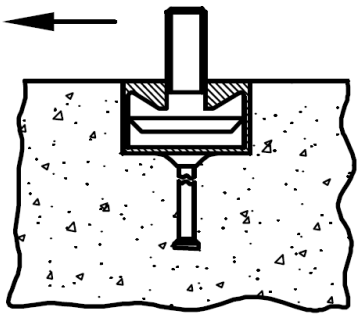
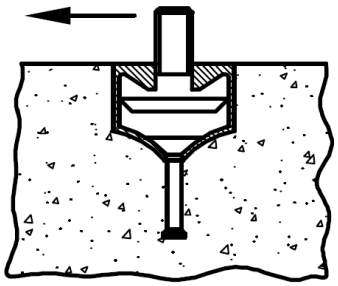
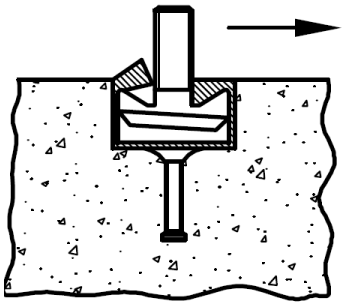
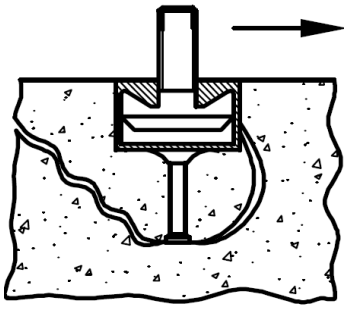
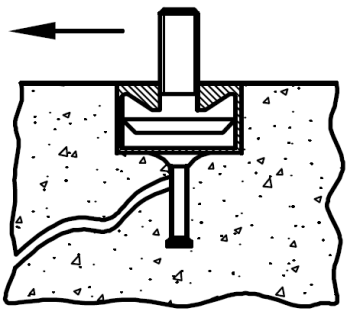
Sl. No.	Failure mode	Details
(viii)	Concrete splitting failure	
(ix)	Concrete blow-out failure	

Table 5 Verification in shear for cast-in anchor channels
(*Clause* 9.2, C-2)

Sl. No.	Failure mode	Details
(i)	Channel bolt	
(ii)	Anchor	

Sl. No.	Failure mode	Details
(iii)	Connection between anchor and channel	
(iv)	Local flexure of channel lip	
(v)	Concrete pry-out failure	
(vi)	Concrete edge failure	

ANNEX D
(*Clause* 5.4)

SAMPLE FORM FOR CERTIFICATE OF COMPLETION OF WORK BY INSTALLER

With respect to the installation of post installed anchor in …… Project, on Plot No ..... in Colony/Street ..... Mohalla/Bazar/Road ..... City....., we certify

a) that the installation has been executed by us according to the structural design and drawings issued to the site by the Structural Engineer, and

b) that the work has been completed with high level of workmanship observing due diligence and all the materials have been used strictly in accordance with the detailed specifications and in compliance with the Manufacturer's Printed Installation Instructions (attached herewith), using the designated installation tools.

The checklist containing all information is as follows -

Detail of fixing device	
Detail of fixing device type	cast-in place anchor/ cast-in anchor channel/ expansion plug anchor/ nails
Name of the fastening device	
Make of the fastening device	
Diameter of the fastening device (mm) *(except cast-in anchor channel)*	
Embedment depth of the fastening device (mm)	
Length of the fastening device (mm) *(for cast-in anchor channel)*	
Base material and grade	Concrete/ masonry (brick/AAC), compressive strength in N/mm^2
Calibrated torque wrench/ machine torquing, if applicable	If applicable
Installation torque (Nm)	If applicable
Use of setting tool for expansion plug anchors or nails	Tool name or configuration (energy setting for power actuated fasteners

Signature of authorized personnel of the installer

Name (in block letters): ……

Address: .....

Date: ……