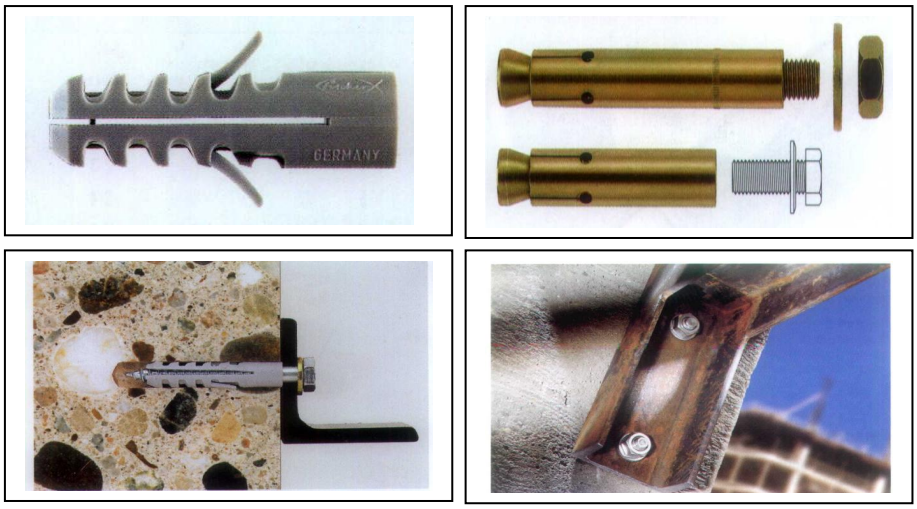
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सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Modern fixtures and fixing systems for civil structures



CAMTECH/2004/C/FIXTURES/1.0
February - 2004

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Modern fixtures and fixing systems for Civil structures

Foreword

To improve the productivity & performance of manpower resource on Indian Railway, it is essential to enhance and update their technical know-how regarding modern technology. Modern fixtures and fixing systems is an advanced technology, now being used and adopted all over the world by many civil engineering organisations.

This handbook has been prepared with the objective, to provide an introductory knowledge about modern fixtures and various fixing systems and their wide range of applications in civil engineering, to the Indian Railway technocrats. It includes detailed technical and pictorial study regarding fixtures and fixing systems.

I am sure it will be a valuable source of technical know-how regarding modern fixing/anchor systems to civil engineering officials & field staff, of Indian Railway.

CAMTECH/Gwalior ***C.B.Middha***
Date : 11 .02.2004 ***Executive Director***

Preface

In current scenario, Indian Railways is touching new dimensions in the field of technology by adopting technological advancement and modernisation. The present handbook "**Modern fixtures and fixing Systems for Civil Structures**" is a small effort in the same direction by the civil engineering branch of CAMTECH. It comprises of the study related to the use of modern fixtures & fixing systems, covering basic of fixing technology, types of anchors/fixings, their installation procedure and various applications in civil engineering.

Application of modern fixing system can be done in various field of civil engineering like petty maintenance works, sanitary fixing, construction of steel structure, interior decoration etc. It improves significantly the quality and finish of the work. Due to ease and quick installation these modern anchors/fixings, results in time & cost saving in comparison to conventional practices for the same work.

A elaborated details has been given in this handbook regarding all types of anchors and fixing systems, but the selection of anchor or choosing the right fixing system is a very case-sensitive procedure. Hence, it is advisable to the user, to consult the manufacturer's specification and technical guidance before selection of anchors for a particular job.

This handbook does not supersede any existing instructions from Railway Board, RDSO & Zonal Railways and the provisions of IRWM, on the subject. This handbook is not statutory and contents are for the purpose of guidance only.

I am grateful for the assistance given by Shri Anupam Sharma, CTA/Civil, who went through the complete text/graphics, collected information, data etc. and done text-editing work. Nice data entry & formatting has done by Shri Ramesh Bhojwani, Console Operator, CAMTECH.

We welcome any suggestions for further improvement from our readers.

CAMTECH/Gwalior ***Manoj Agarwal***
Date : 10.2.2004 ***Director/Civil***

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ISSUE OF CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows:

CAMTECH/2004/C/FIXTURES/1.0/CS. # XX date .....…….....

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

Sr. No. of C.Slip	Date of issue	Page no. and Item No. modified	Remarks

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CHAPTER - 1

Introduction

The advanced fixtures and fixing system has now been introduced in India also and is well adopted for civil engineering structures by many construction organisations. Nowadays, fixing technology has been widely used in modern building/structure to fix the various types of component like false ceiling, sanitary fittings, staircases, interior finishing/partitioning items, exterior finishing/cladding, brackets, columns, railings etc. to the main structure. Fixing technology has made revolutionary changes in building construction technique as it has many advantages like, time saving, systematic working, improvement in finish including economy & safety over conventional practices.

This technology may be used in various stages of construction. During construction for fixing scaffolding, anchor bolts, brackets, staircases etc. In interior finishing of structure, for fixing false ceiling, panelling, partitioning, door/window frames and various utility items. These anchors/fixings are also useful for making alteration/modification in building use or layout during its life.

On Indian Railways these fixings/anchors can be use for fixing, low to medium load general utility items, fixing of doors/windows frames, panelling, erection of steel structure, sanitary fixing, cladding, false ceiling, special fixing etc. It is also useful in making alteration/modifications in the structure/building by using **rebar** concept.

The main component of this technology is called anchor/fixing, which is made of metal or plastic. These anchors are designed in many types and shapes keeping in view the specific requirement of the component, which is to be fixed to the main structure. These anchors depending on mechanism of transmitting the load, may be categorised as follows:

Friction locking : The anchors expanding part is pressed against to drill hole wall and thus it bears the load through friction.

Form locking : The anchors specific geometrical design adopts interlocking to the shape of the substrate and bears the load through locking.

Bonding : The anchors is bonded with the substrate making a integral material with the use of synthetic resin or epoxy mortar.

These fixings/anchors are approved in various countries world over and are covered under the standard specifications. However in Indian conditions these fixings/anchors shall be used, keeping in view, the requirement and the manufacturers recommendations.

In the subsequent chapters, the various modern fixings/anchors has been elaborated in details, covering mechanism of their working, the types and groups of fixings/anchors systems available, with their suitability for different building materials and applications.

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CHAPTER – 2

Basics of fixing system

To decide the most effective fixing/anchoring system for a given condition/application it is essential to have a knowledge of various technical aspects of fixing system i.e. anchor base, drilling method, anticipated loads, type of installation/mounting, anchoring mechanism & classification, and type of failures of fixtures etc.

All the above aspects has been briefly dealt as under :

ANCHOR BASE

The type and composition of the building material (i.e. anchor base) in which the fixing is to be anchored, is the important factors in determining the effectiveness and selection of appropriate fixing system. The various type of building materials commonly used are classified as under :

(i) Concrete
(ii) Masonry
(iii) Boards type

♦ **Concrete :** It is further sub-divided into two sub groups i.e.

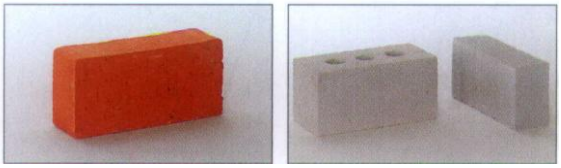
- Normal concrete
- Light weight concrete

Light weight concrete is manufactured from light weight aggregates such as pumice, expanded clay etc. as a result it normally has lower compressive strength then the normal concrete.

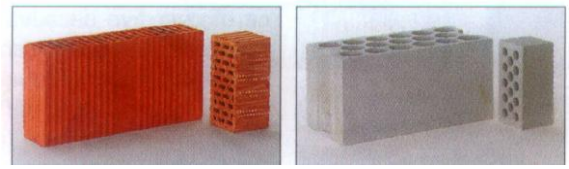
The load bearing capacity of the anchoring system depends upon the strength of the anchor base therefore light weight concrete are having less favourable condition for anchoring the fixing device particularly heavy duty fixing.

♦ **Masonry :** It is a composite material comprising of bricks/masonry unit and mortar. Depending upon the a type of masonry unit used it is further sub-divided in four sub groups.

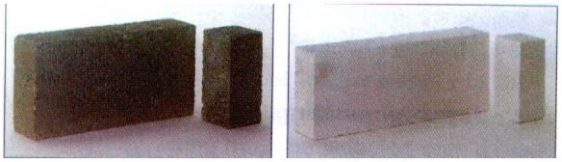
- **Solid compact structure :** It comprises of masonry unit such as solid bricks or sand lime solid bricks. It is highly suitable for fastening systems since it has no or less cavities and has high compressive strength.



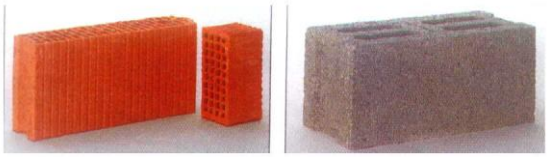
- **Perforated compact structure :** It comprises of masonry units manufactured from the same compressive strength material as the solid bricks but are provided with cavities. For introducing higher load in this category of base anchor, a special fixing system is to be used i.e. those, which bridge or fill out the cavities.



- **Solid with porous structure :** It comprises of masonry units made of light weight concrete or light expanded clay aggregate or aircrete. These building material have low compressive strength and many pores with proportion of perforation more than 15%, therefore for effective anchoring special fixing arrangement are required i.e. those with a large expansion surface or fixing with a form locking grip.



- **Perforated with porous structure :** It comprises of perforated masonry units made from light weight concrete or expanded clay etc. This types of base anchor have very low compressive strength with nos. of cavities and pores. With these material selection of anchoring system needs special care for effectiveness. Fixing with long expansion zone or form locking anchors are more suitable.



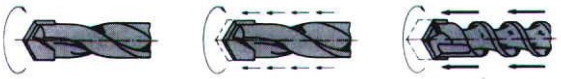
♦ **Boards type :** This 3rd main group contains thin walled building material which normally have low strength i.e. gypsum plaster boards, gypsum fibre boards, chip boards, rigid fibre boards, plywood etc. The fixing system for such material have a form locking action i.e. anchoring directly at the reverse of the boards in the cavity. The fixing arrangements for such material are normally termed as **cavity fixing**.

HOLE DRILLING

♦ **Methods**

For installing the fixing/anchoring system, normally the holes are required to be drilled in the anchor base. The commonly used drilling methods are as under :

- **Rotary drilling**
- **Percussion drilling –** Comprises of rotary drilling with large nos. of light impact during drilling, by using percussion drilling machine.
- **Impact drilling –** Comprises of rotary drilling with smaller no. of impacts but with high impact energy during drilling, by using electro-pneumatic hammer drill.
- **Diamond drilling :** It is used mainly for production of larger diameter hole or where steel reinforcement is encountered in concrete.



Rotary Percussion Impact

The drilling process to be adopted, is determined by the building material :

- **Solid material with dense structure :** Impact and percussion drilling.

- **Perforated brick and low strength material :** Rotary drilling only to prevent the hole from becoming too large and the walls from breaking.

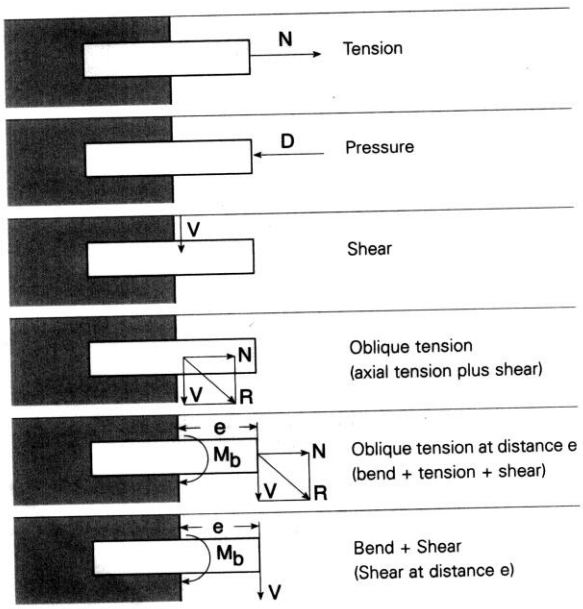
- **Concrete :** Percussion drilling
  To improve the speed of drilling without impact, use carbide tipped bits which are ground sharp in the same way as a steel drill.

♦ **Hole cleaning :** After drilling, the drill dust must be removed, as the un-cleaned drill hole will reduce the load carrying capacity. Since the drill dust acts like a loose chipping on the road. Blow pump is normally used to clean the hole.

♦ **Hole depth :** The depth of the drilled hole shall be kept slightly larger than the recommended anchoring depth for the fixing system used. It will ensure space for an screw protruding from the plug tip or to leave a room for any dust remaining in the hole, and will assure that the function of the fixing is not impaired.

LOADS

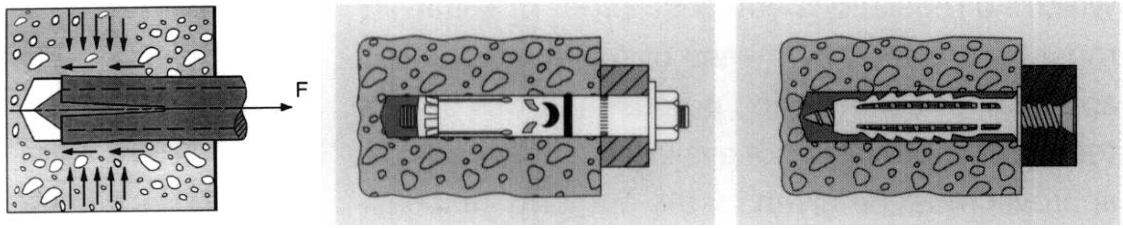
For selecting the appropriate fixing system beside type of anchor base, the loads to which the fixing arrangement is subjected is also very important. Loads are characterised by size, direction & point of application as under :



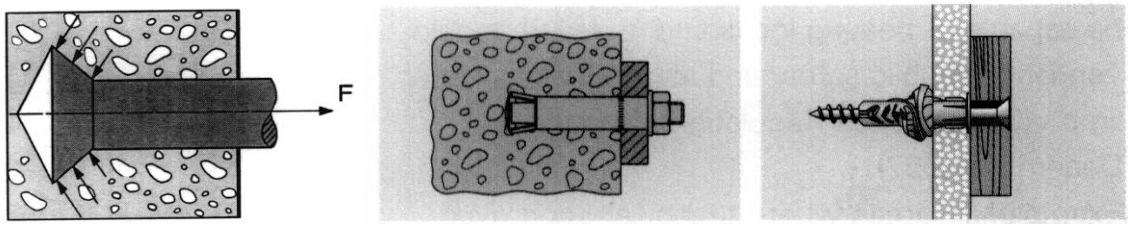
CLASSIFICATION OF ANCHORS

Depending upon the mechanism of transmitting the attachment load to the anchor base, the anchoring system are classified as :

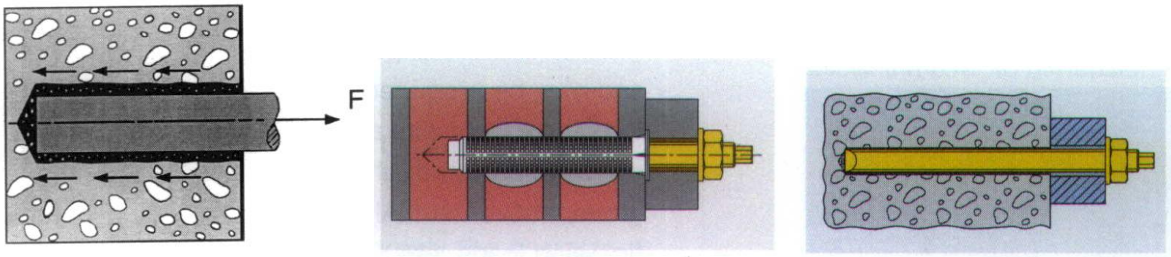
- **Friction locking :** The expanding part of the fixing is pressed against the drill hole wall and bears the external loads through friction. This is also known as **expansion fixing**.



- **Form locking :** Fixing geometry adapts the shape of the substrate or drill hole, thereby transferring the load evenly to the substrate.



- **Bonding :** In this transfer of force from the fixing to the anchor base takes place via a third substance i.e. polyester resin, vinyl ester mortar or a special mineral based mortar. This fixing exerts no expansion pressure on the substrate hence requires much smaller axial and edge distance.

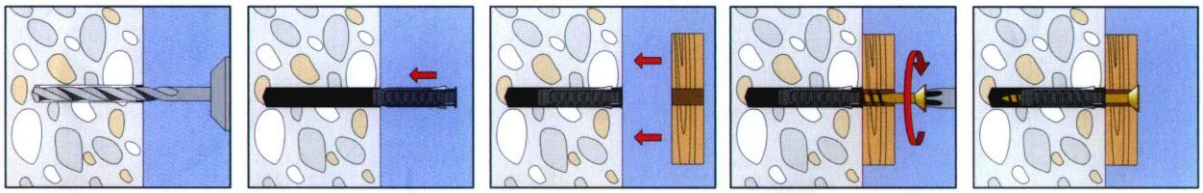


Anchors may drive their holding power through a combination of above mechanism. e.g. Expansion anchor which works on friction mechanism, at the time of expansion of the fixing it causes a permanent local deformation in concrete, which allows a keying of the expansion sleeve in the base material thus giving a secondary mechanism of holding power. Similarly chemical anchors in addition to bonding also have a local keying action due to infiltration of the adhesive into pours of base material.

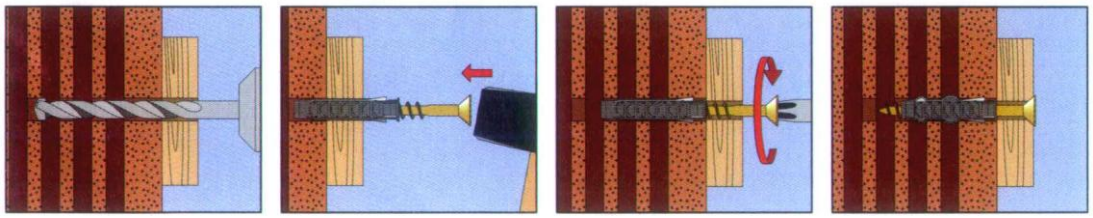
TYPE OF INSTALLATION

Depending upon sequence/procedure of fixing the component to anchor base and its position with respect to anchor base, installations/mounting are grouped as under :

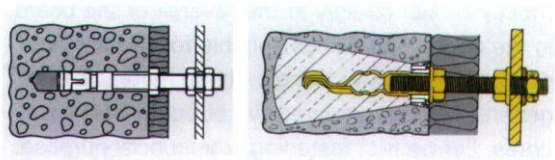
- **Attachment installation :** In this component is fitted flush with the anchor base material surface. The drill hole in the anchor base is larger than the hole in the component being connected. **Procedure** – Mark the hole pattern of the fixture/component on the anchor base, drill the hole, insert the fixing and screw the fixture into place.



- **Push through installation :** In this a hole is drilled in the anchor base through the fixture to be fastened. The fixing is then placed in position through fixture/component and then expanded. This type of installation is preferred when more than two fixing per fixture/ component are required.

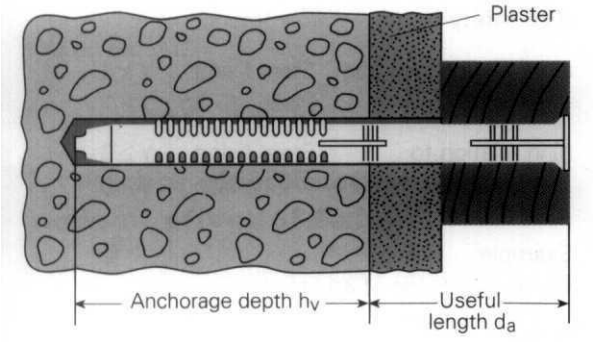


- **Clearance installation :** This type of installation is used for connecting the component in a pressure/tension resistant manner at a certain distance away from the anchoring surface/anchor base. It is also known as **installation at distance**.



ANCHOR LAYOUT

To avoid chipping and crack formation in anchor base material, and to transfer the necessary load with fixing arrangement effectively. The layout of the anchor/fixing i.e. anchorage depth, useful length, edge distance, axial spacing and the necessary component width and the thickness shall confirm to manufacturer's specification for application under consideration, load anticipated and the fixing system used. For plastic/nylon fixing an edge distance of twice of anchorage depth and axial spacing of four times of anchorage depth are usually kept.



- **Anchorage depth :** It is a load bearing installation depth in the substrate. For metal and plastic fixing, it is equal to the distance between the upper edge of the supporting structure and the lower edge of the expansion section.

- **Useful length :** It is generally equal to the thickness of the fixture/component being installed. In attachment installation it can be varied by the selection of screw length, in push through installation it is dictated by the fixing. If the anchor base is provided with rendering or insulation material on the face, a screw or fixing should be selected with the useful length equal to atleast thickness of the rendering and fixture being mounted.

- **Axial spacing :** It is the distance between the centre of fixings when they are installed in the rows.

- **Edge distance :** It is the distance between the axis of the fixing and the free edge of the structure. To transfer the maximum possible load a certain edge distance is required to prevent the structure from split open, due to expansion forces in the vicinity of the edge.

ANCHOR FAILURE

The failure of fixing/anchoring arrangement may occur due to over-stressing of anchor points, incorrect installation and due to inadequate load bearing capacity of anchor base material.

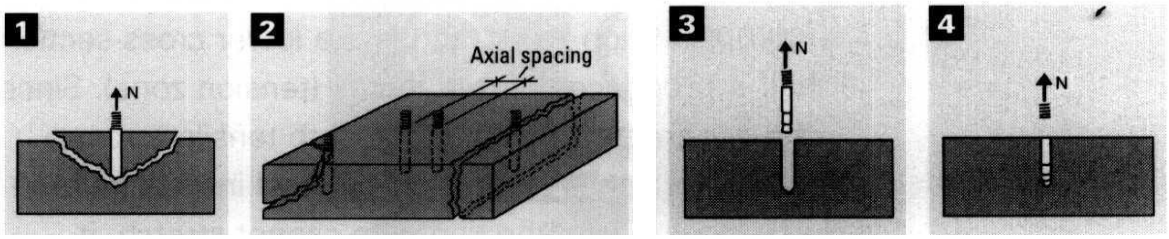
Commonly observed failure of anchoring system are as under :

1 Break out of anchor base
- Excessively high load "N".
- Inadequate strength of anchor base
- Setting depth too low

2 Splitting of component
- Component dimensions too small
- Edge distances and axial spacing not observed.
- Expansion pressure too high.

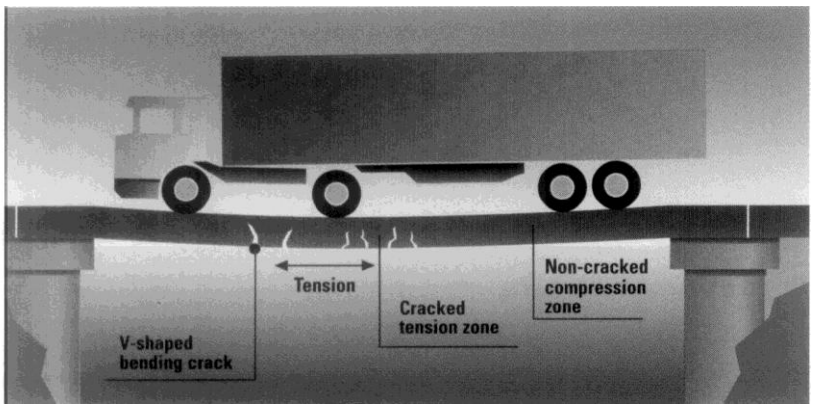
3 Fixing being pulled out
- Friction, bonding agent or form locking system fails through excessively high load or incorrect mounting.

4 Fracture of fixing
- Fixing or screw strength too low for suspended load.



ANCHORING SYSTEM FOR CRACKED TENSION ZONE

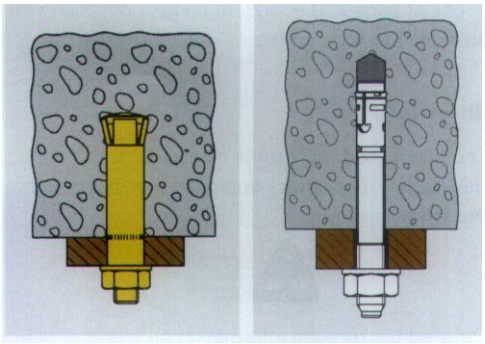
Concrete is weak in tension therefore to cater an axial/ bending tension in concrete member steel reinforcement is provided in tension zone. As concrete can not stretch, it cracks into countless fissures scarcely visible to naked eye, hence this zone is known as cracked tension zone. In building/structures the underside of beam and slab are the typical location of cracked tension zone.



The anchoring systems with :

(i) form locking i.e. mechanical interlocking arrangements in an undercut drill hole, where the oversize conical parts prevents the anchor from being pulled out, even when the crack opens up or

(ii) fixing which automatically compensate the increase in diameter of drill hole by cone pushing deeper into the expending part thus enlarging the diameter of expanding part, are more suitable for such condition.



Under cut anchor Sleeve anchor bolt

CARRYING CAPACITY OF ANCHORS

It is characterised as under :

a) **Ultimate loads** (mean value from atleast 5 individual tests in unbroken building material). Failure criteria may be : failure of the anchor base or the fixing being pulled out or fracturing.
b) **Characteristic loads** (5% fractile, i.e. in 95% of all cases these loads are reached or exceeded)
c) **Permissible loads :** These are working loads which already contain an appropriate safety coefficient. These loads are contained in the approval decisions and apply only if the approval conditions are observed.
d) **Recommended loads** or maximum working loads. It is determined from a ultimate or characteristic loads by applying factor of safety. Normally, factor of safety equal to 4 & 7 are adopted for steel/metal & plastic fixing respectively.

TYPE OF ANCHORS/FIXINGS

Anchors/fixings available can be grouped as under :

- **General fixings.**
- **Frame fixings.**
- **High performance anchors.**
- **Chemical anchors.**
- **Cavity fixings.**
- **Sanitary fixings.**

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CHAPTER – 3

General fixing

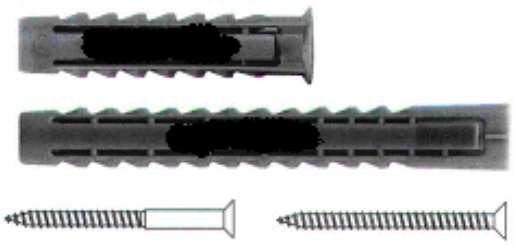
These fixings/anchors are suitable for mounting of various small to medium load attachment i.e. fixing wall mounted shelves, light wall cup boards, curtain rails, light coat racks, skirting, light brackets, electric switch, cable ducts and clips, lamps, towel rail, mirror, cabinet, soap dishes, picture frames, wall mounted clocks, hanging baskets, letter box etc.

These general fixtures are further sub group in plastic and metallic type.

PLASTIC FIXTURES : These are manufactured from **nylon** i.e. high quality polyamide which ensures resistance to weathering, ageing, rust and rot. These are capable of withstanding temperatures from -40^0C to $+80^0$C. Fixing made of polypropylene are also available. They have dampening properties with good electrical insulation. These are available in following forms.

- Plugs
- S-plug
- Universal plug

- **PLUGS –** It works on expansion principle i.e. friction mechanism. It is available in two types i.e. small & large.



Small – **Suitable for** solid building material

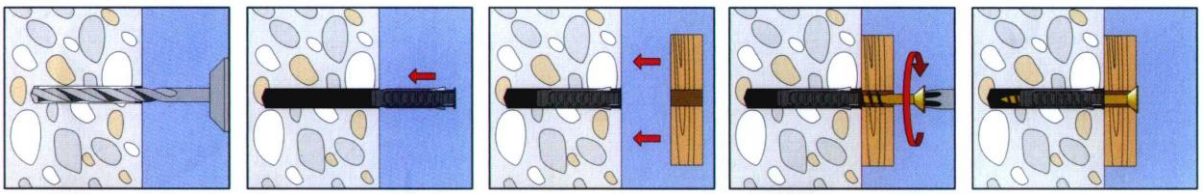
Large – **Suitable for** perforated building material

Wood Screw **Chip board screw**

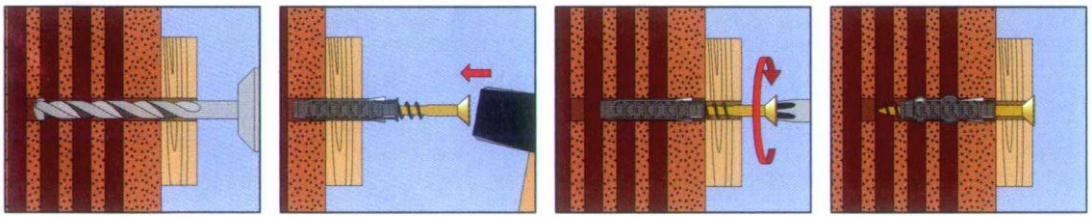
- **Used for fixing** - All objects, which can be fixed with wood screw or chipboard screw, for attachment and push through installation.

Installation procedure

Attachment installation

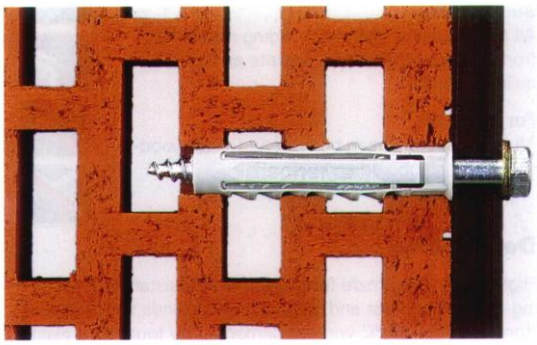


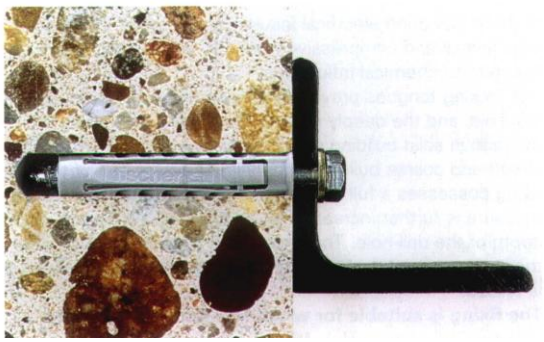
Push-through installation



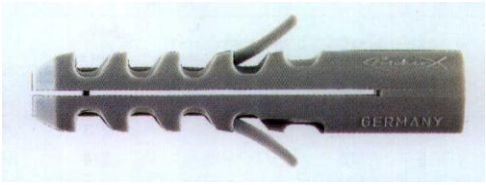
For proper installation screw with max. recommended diameter shall be used, and screw shall project beyond fixing tip, atleast equal to screw diameter.

Application examples





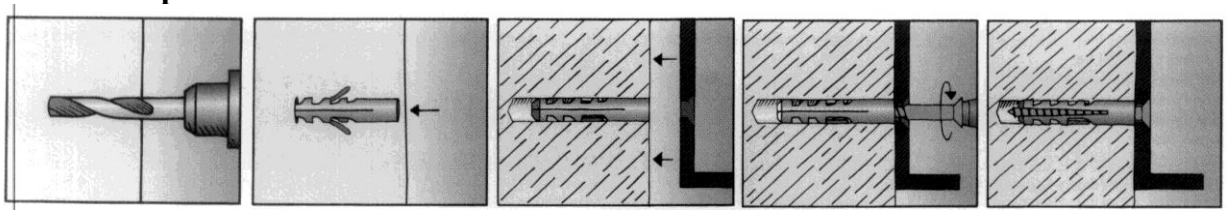
- **S-PLUG –** It is a further refinement of plug, and is provided with locking tongues, which prevents the fixing from co-rotating in the drill hole and deeply shaped teeth provides anchoring by friction grip in solid building material or by positive form locking in soft and coarse building material. Neck of the plug is free from expansion pressure, therefore does not causes chipping of rendering or damage to tiles.



Suitable for - All types of materials.

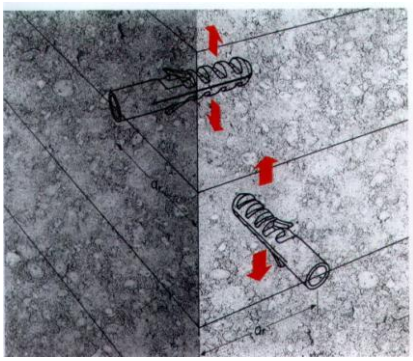
Used for fixing - All objects, which can be fixed with wood screw or chipboard screw, for attachment and push through installation.

Installation procedure

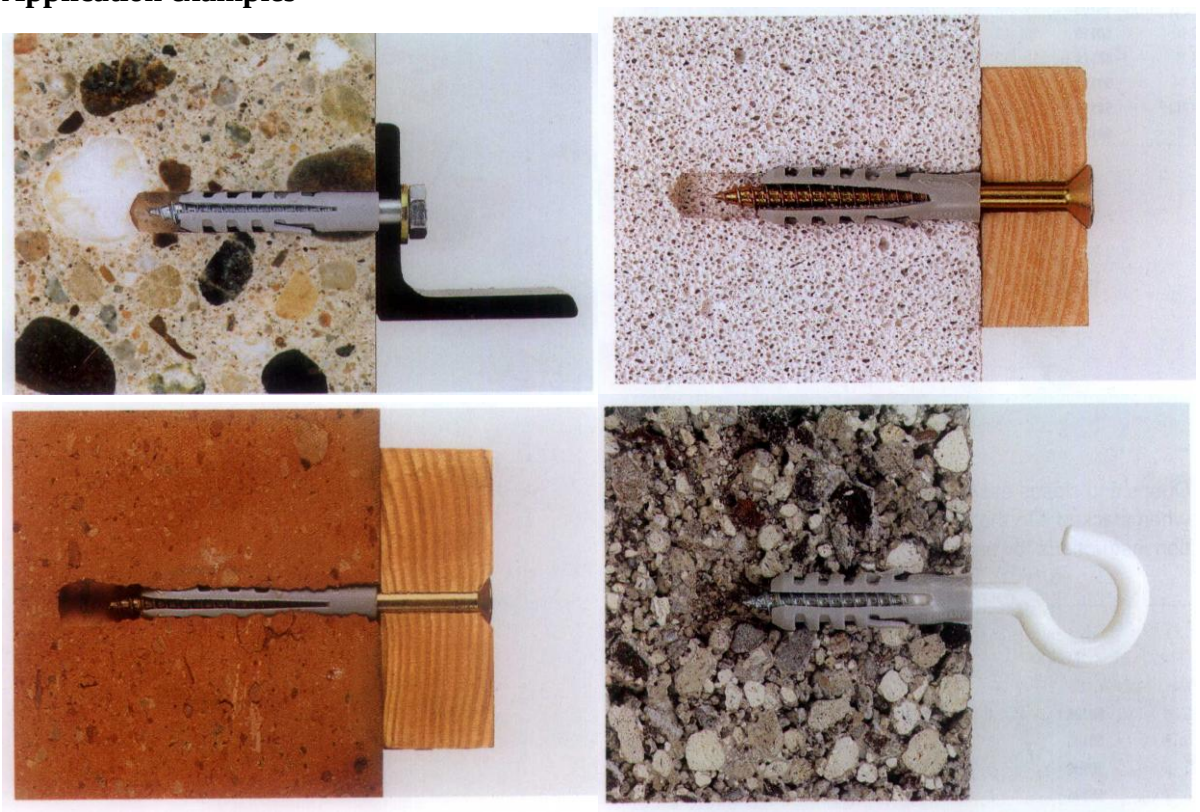


For proper installation screw with maximum recommended diameter shall be used, and screw shall project beyond fixing tip, atleast equal to screw diameter.

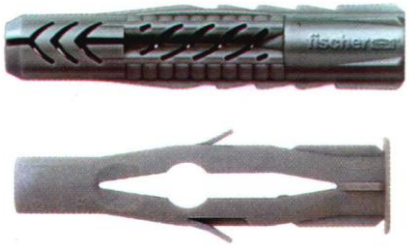
A distance of atleast one fixing length shall be kept from the wall edge and the plug shall be fixed in such a way that the direction of expansion acts parallel to the edge, as shown in figure below.



Application examples



UNIVERSAL PLUG : It is multipurpose fixing which grips solid material by friction and perforated brick or hollow walls by form locking. It combines two principles of expansion and folding.



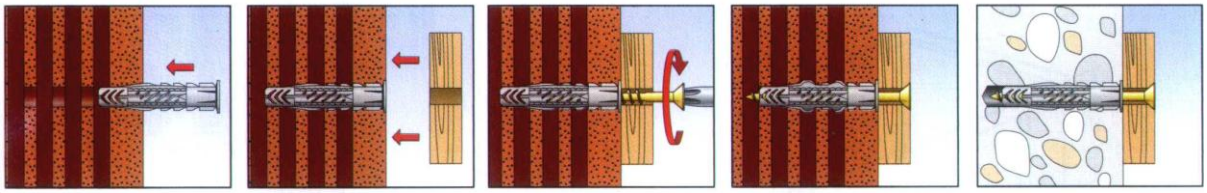
When installed in solid material, plug is inserted into the hole without a screw and is compressed. When the screw is inserted the nylon material expands and the hole surface is pressed evenly against the wall of the hole. When it is used in hollow brick or plasterboard the fixing folds out side ways when the screw is tightened thereby creating a form locking. Maximum folding is achieved when chipboard screw are used.

Suitable for - All type of materials.

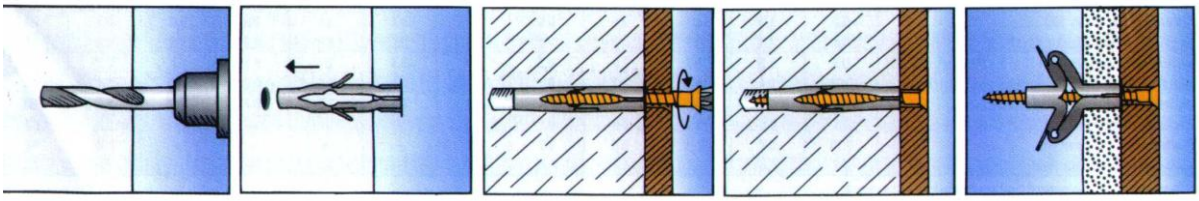
Used for fixing - All objects, which can be fixed with wood screw or chipboard screw, for attachment and push through installation.

Installation procedure

For soft building material



For solid/board material

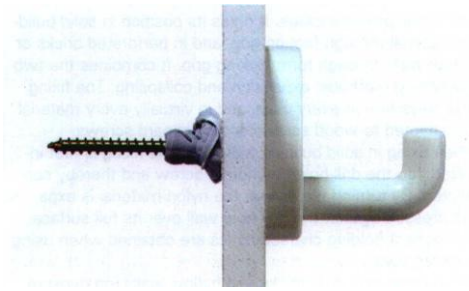


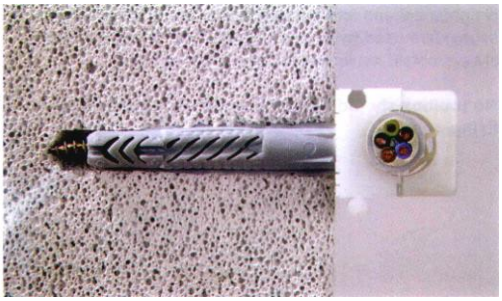
On solid **On board**

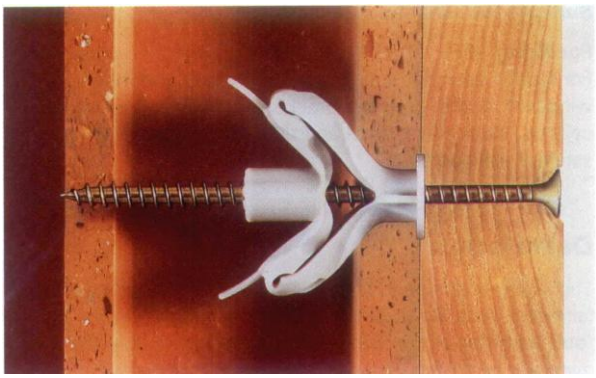
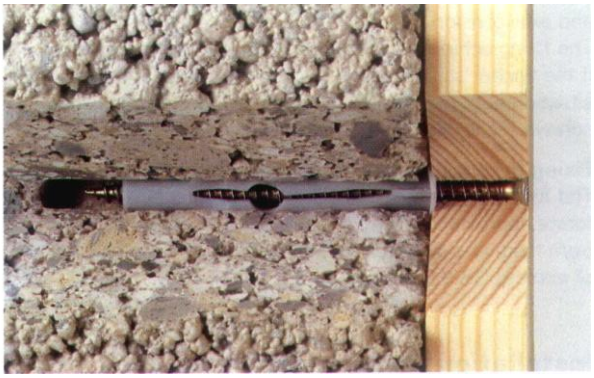
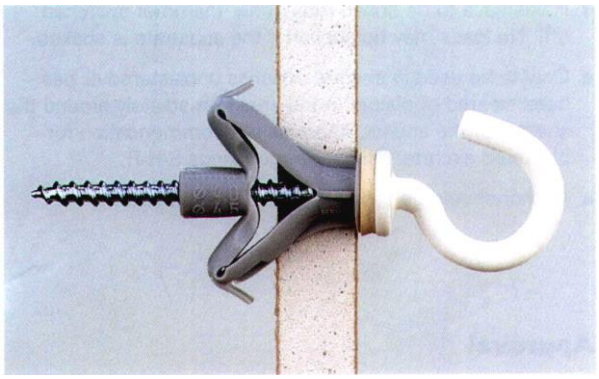
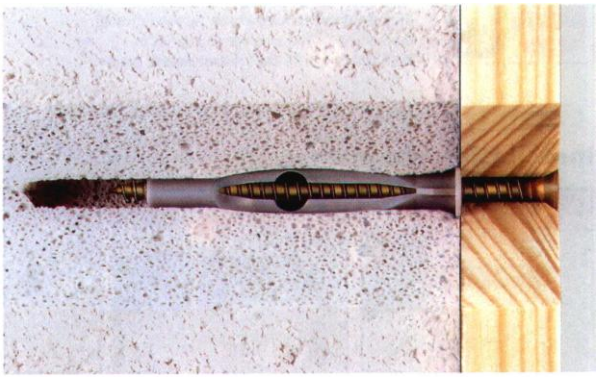
For proper installation screw with maximum recommended diameter shall be used, and screw shall project beyond fixing tip, atleast equal to screw diameter.

Application examples





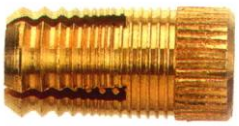


METALLIC FIXTURES

These fixings are made of metals, for light to medium load carrying capacity. They require small/shallow setting or anchor depth, and are normally available in plug form.

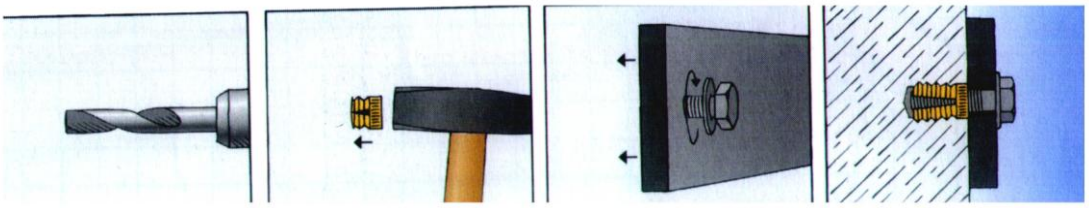
PLUGS – It is made of brass, and works on expansion principle i.e. friction locking. The anchoring depth required is small i.e. 7.5 to 25 mm, and it is secured against rotation through knurling. Component can be removed and reattached any nos. of time & fixing can be used with various type of metric screws.



Suitable for - Fibre cement boards, chip boards, solid wood, ply-wood, plastic, artificial stone, natural stone, laminated boards, solid bricks etc.

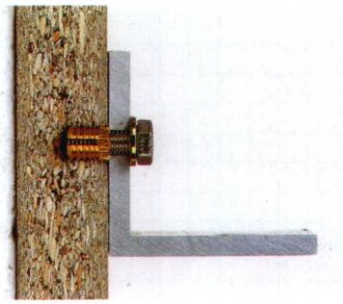
Used for fixing - Retaining angles, furniture fitting, accessories etc.

Installation procedure

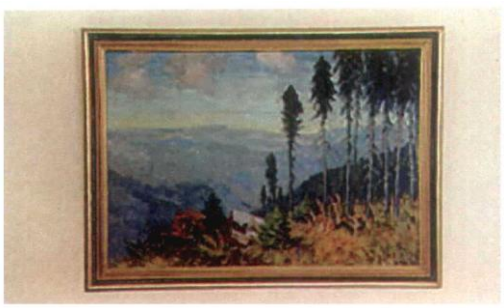


For proper fixing it shall be screwed atleast for the depth equal to thickness of the attachment.

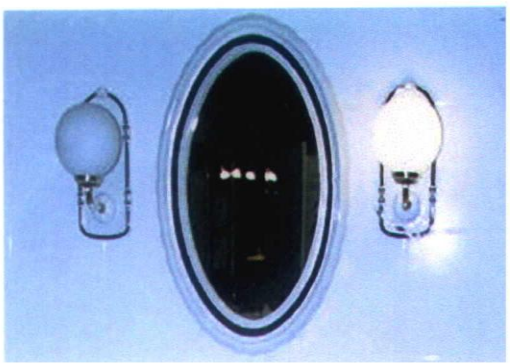
Application examples



Other applications of general fixing





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Go to index

CHAPTER - 4

Frame fixing

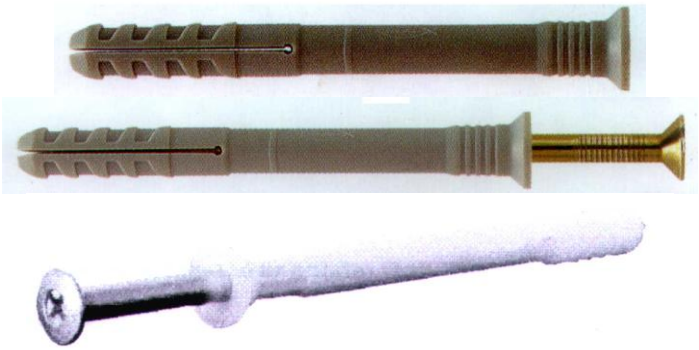
These fixing have long shaft for fastening the element by push through installation and are suitable for fixing of timber battens, timber/metallic doors & window frames, roof edge, wall connection, skirting boards, sheets, insulation material, panelling etc. Installation of these fixing are very simple, press the component/attachment against the wall, drill through it, push the fixing through it from the outside, tightened the screw and the job is finished.

These fixtures are further sub-group in plastic, metallic fixtures & adjustable type.

PLASTIC FIXTURES : These are normally made of nylon, and are available in following forms.

- Hammer set fixing
- Universal frame fixing
- S-type fixing

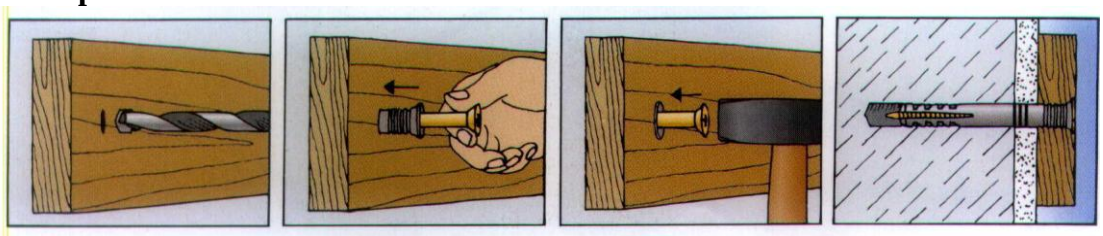
- **HAMMER SET FIXING :** These are expansion/friction fixings, which are simply locked into position with a hammer. They are mainly design for push through installation and are supplied with pre-assembled screw nail. Screw nails are provided with saw tooth threads, which are easy to tapped in and easy to screw out. The tapped in lock prevents the premature expansion during insertion.



Suitable for - Concrete, solid/perforated bricks and hollow blocks etc.

Used for fixing – Timber battens, frames, roof edge, skirting boards, wall angles, sheets etc.

Installation procedure



For proper fixing in perforated and hollow blocks, the fixing length shall be so decided that the expansion piece fully covers atleast one brick/block web.

Application examples



- **UNIVERSAL FRAME FIXING :** It works in solid building material on expansion/friction mechanism, and in hollow building material on combined mechanism of indenting, positive locking i.e. form locking and expansion. It is more suitable for push through type of installation.

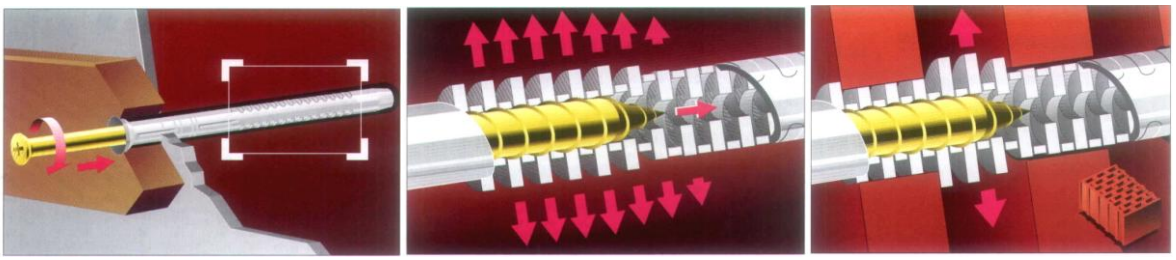




Suitable for - Concrete work of all type, gypsum plaster board, natural stone and other building material of low compressive strength.

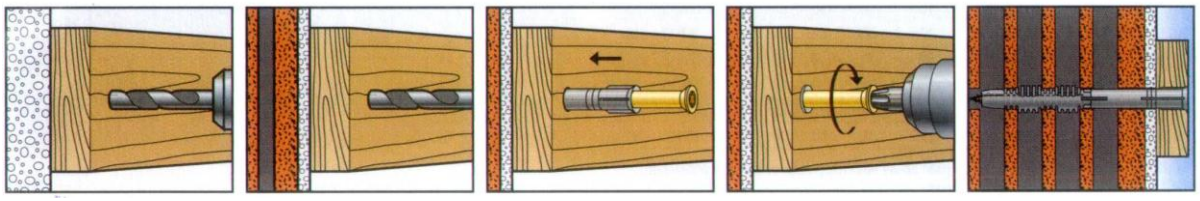
Used for fixing - Façade fixing (wooden/metallic sub-structure) i.e. anchoring of beams/frames, metal consoles, supports, rails etc. on outer walls. These are also used for anchoring of beams laths, metal angles and similar metals mainly in the interior. These are also useful for miscellaneous fixing of different wooden, plastic and metal parts such as radiators, cup-boards remedial walls, tiles, shelves etc.

Mechanism



In Solid material In hollow/perforated material

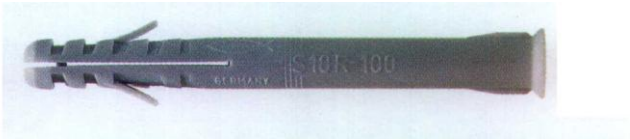
Installation procedure



Application examples



- **S-TYPE FIXING :** It works on expansion/friction mechanism similar to S-Plug. These fixings are of pre-assembled type i.e. screw is already inside the plug/fixing & are available in two types.



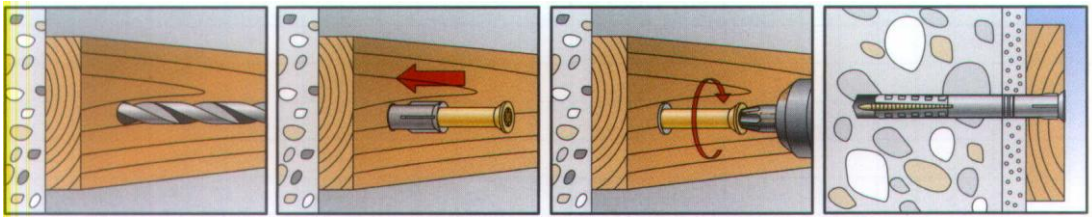
Suitable for - Concrete solid bricks, natural stone etc.



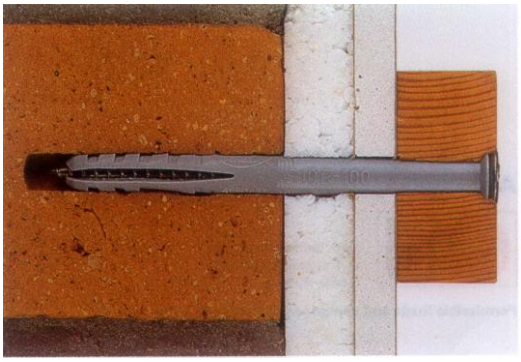
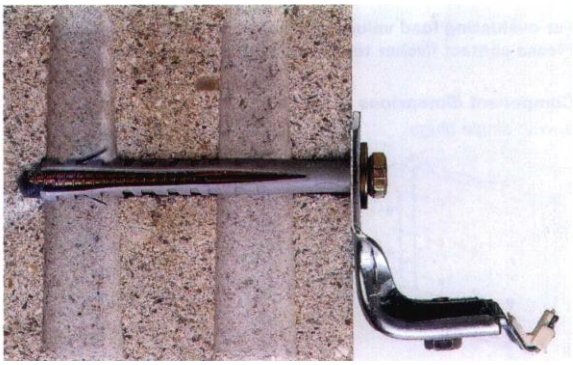
Suitable for - Perforated & hollow bricks as well as solid building material with low compressive strength

Used for fixing- Mainly push through type installation of, timber beam, wooden laths, batons, façade, cladding & roof substructure made of wood, metal and plastic window/door frames, panels etc.

Installation procedure



Application examples

- **METAL FIXTURES :**

  These fixings are made of steel with corrosion protection. Due to metal sleeve they have high lateral resistance compare to plastic fixings.

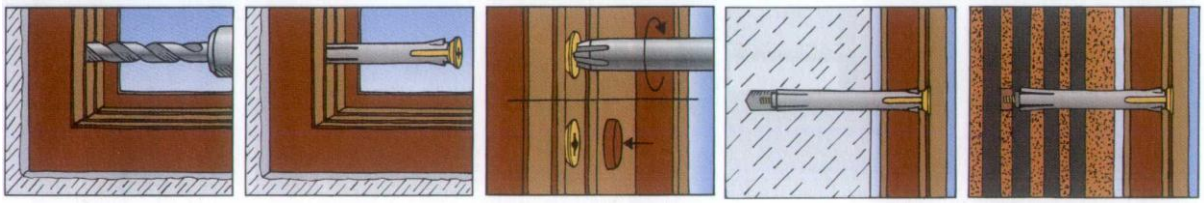
- **SLEEVE FIXING :** It is expansion/friction fixing with long shaft, consisting of cone, expansion sleeve and screw. When the metric screw of the fixing is tightened by a screwdriver or electric screw driver, a cone is drawn into the sleeve and the fixing is expanded without the assembly item being drawn against the building material. Snap in projection on the fixing sleeve provides tension and pressure resistant connection and it is available with counter sunk screw for timber frame and flat mushroom head screw for metal frames.



Suitable for - Concrete solid and perforated bricks, aircrete, natural stone etc.

Used for fixing - Push through installation of window/door frames, wooden batons, timber beams etc.

Installation procedure



Application example



- **ADJUSTABLE FIXING :** It is used for clearance installations for wooden frames/panels. Fixing with screw is knocked into position up to the edge of fixing. Once the screw has been screwed flush, the distance between the wooden frame/fixture and the wall is adjusted by simply turning the screw anti-clockwise.



With the use of these fixing wooden frames can be fixed in position at a distance from a wall without use of blocks/wedges and installation can withstand pushing and pulling forces.

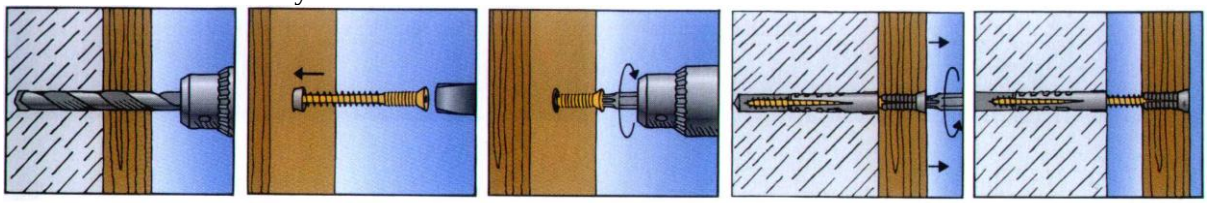
Suitable for – Concrete, solid bricks, natural stone, timber construction etc.

- For installing a timber sub-structure in interior construction work for timber to timber installation, **adjustable screws** are also used.

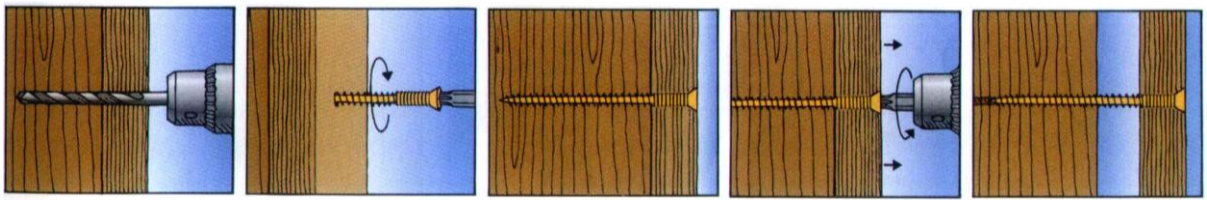


Installation procedure

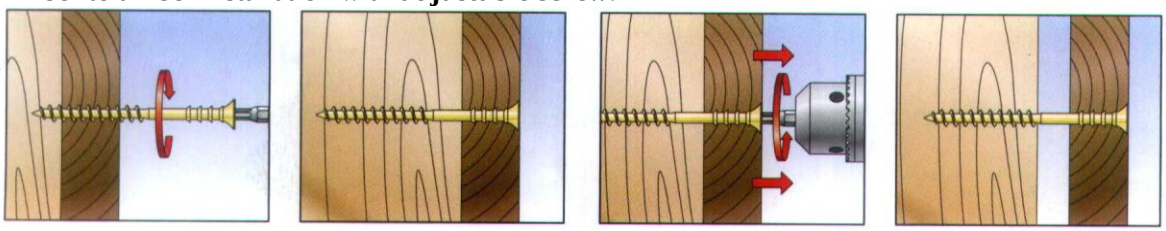
For concrete and masonry



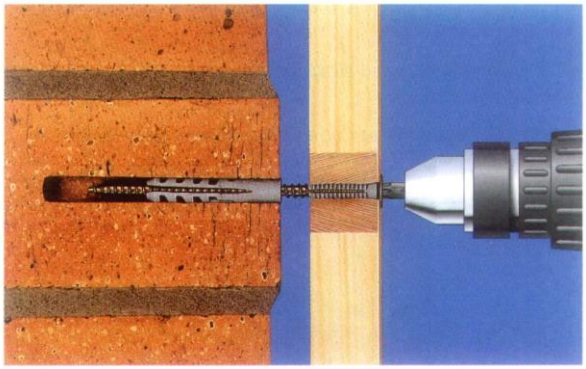
For timber construction

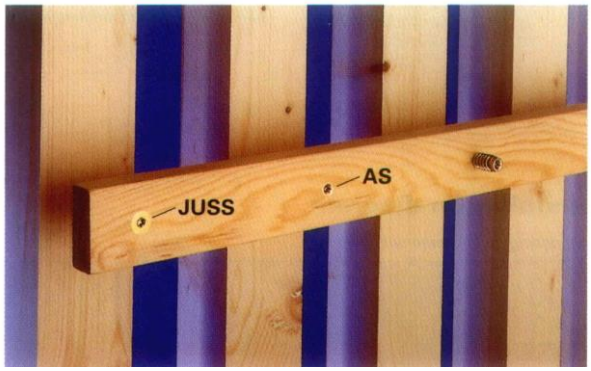


Timber to timber installation with **adjustable screw**.

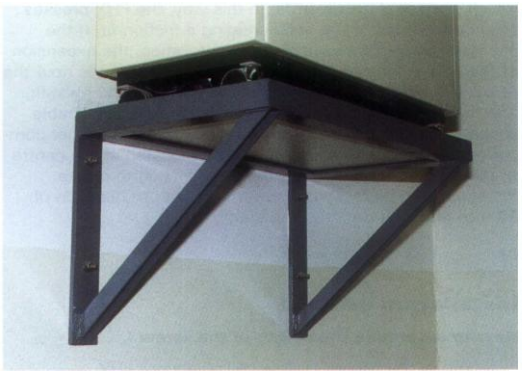


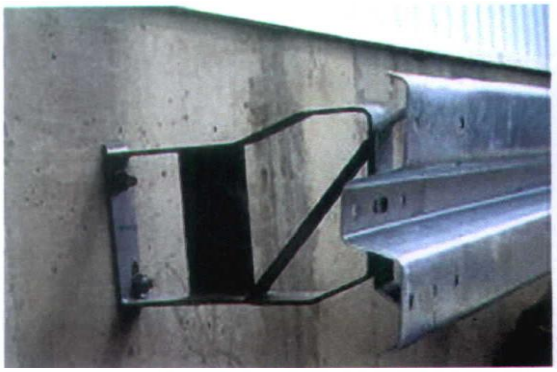
Installation examples



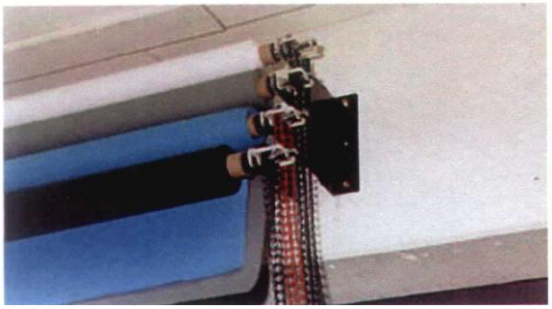


Other applications of frame fixing













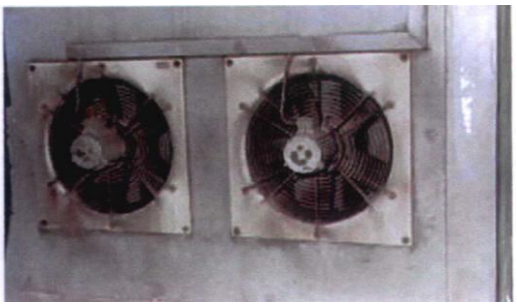





fischer







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CHAPTER – 5

High performance anchors

Anchors capable of carrying heavy loads are termed as high performance anchors. They are mainly made of zinc-plated steel, carbon steel, stainless steel and high corrosion resistant steel. These are available in following forms.

- Under cut anchors
- Under cut hammer set anchor
- Sleeve anchors
- Anchor bolts
- Sleeve anchor bolts
- Hammer set anchors

UNDER CUT ANCHORS : It consists of an anchors sleeve and the cone bolt with external/internal threads. Anchors are installed in cylindrical conical hole for transferring the loads through mechanical interlock i.e. form locking. It is more or less free of expansion pressure thus requires less edge and axial spacing.



Bolt anchor

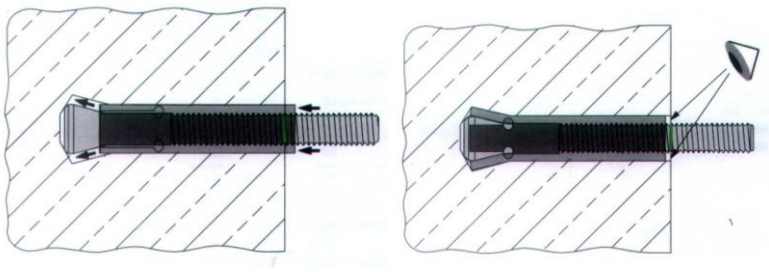
Internally threaded anchor

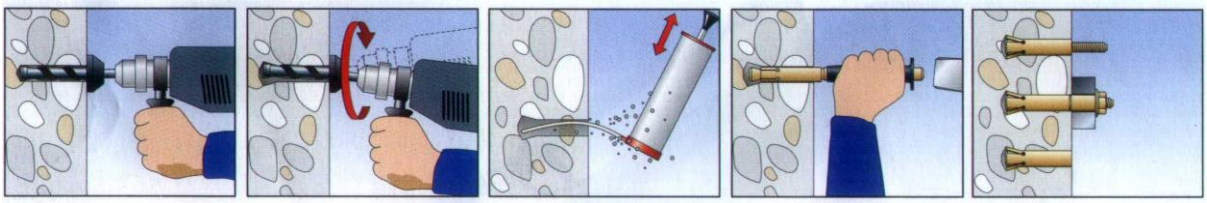
Suitable for - Concrete and natural stone with dense structure. These anchors has high load carrying capacity, even in **cracked concrete**. It can carry a load 22 kN in non cracked and up to 13 kN in cracked concrete.

Used for fixing - Steel fabrication in general, railing, cable tray, anchor rail, consoles, gate, staircase, ladder, cladding, window brackets etc.

Installation procedure

For installing a conical-cylindrical hole is drilled with special bit, after cleaning of hole anchor is installed by driving the sleeve over the cone bolt into the under cut hole by using setting tool.

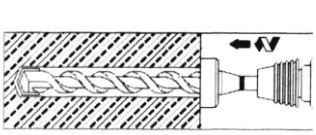




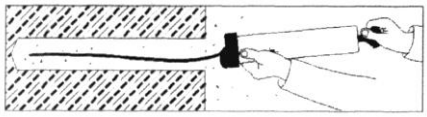
For proper installation, it shall be ensure that the anchor sleeve is atleast 1 mm below the surface of concrete and the drill dia, depth and under cut are exactly as per the anchor.

These anchors are also available in **self under cutting type**. This type of anchors is provided with tungsten carbide tipped sleeve, to act as a cutting edge. For installing these types of anchors, after placing a anchors in cylindrical hole, a special setting tool is guided over the anchor rod to engage the groove in the sleeve. Then anchor is set in position with the use of hammer drill. During the setting process both drilling and impact energy are transferred to the sleeve by the setting tool, causing sleeve to slide over the conical end of the anchor bolt while forming the under cut in the base material.

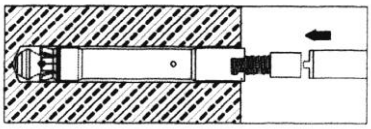




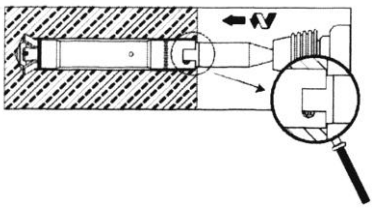
1- drilling



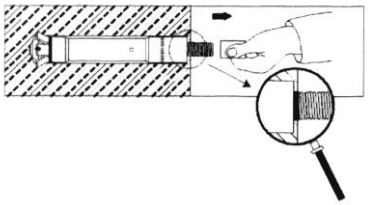
2- cleaning



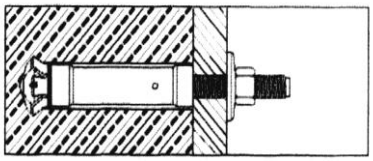
3- insertion



4- installation with self cutting

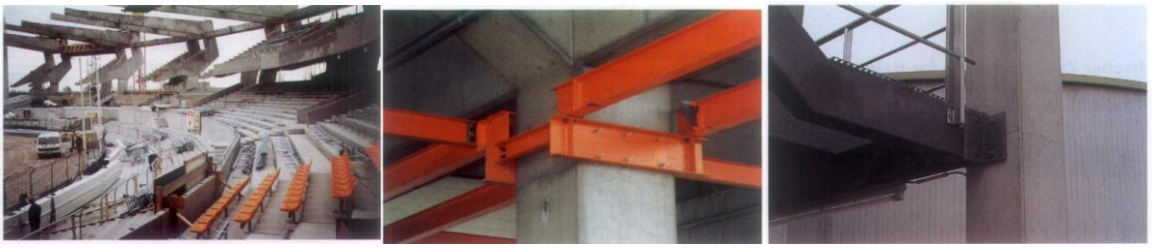


5- removal of setting attachment



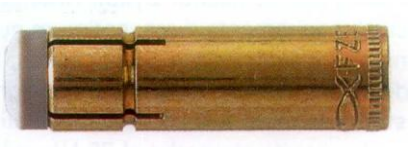
6- fixing of component

Application examples



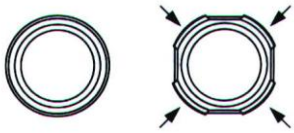
UNDER CUT HAMMER SET ANCHOR

It consists of sleeve with internal threads and cone. It works on positive locking mechanism i.e. form locking in undercut for transferring the load. It is free of expansion pressure thus requires less edge and axial spacing. Anchorage depth is also low, hence suitable for thin building components.



Before expansion

After the correct expansion



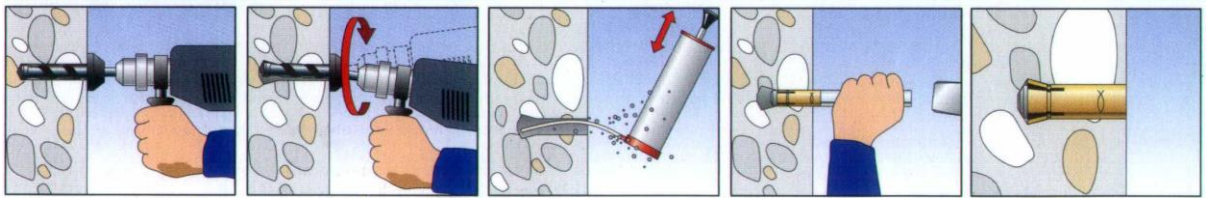
4 imprints for visual check

The anchor is set correctly if the anchor sleeve is flush with the surface of the concrete and the 4 imprints are visual. Therefore it is impossible to set the anchor incorrectly.

Suitable for - Concrete (**cracked** and non-cracked) and dense natural stone. Loading carrying capacity is up to 3.6 kN in non-crack and 1.5 kN in crack concrete.

Used for fixing - Fixing pipes, ventilation systems suspended ceiling, railing, cladding, ladder, chair fixing etc.

Installation procedure



For proper installation anchor sleeve shall be expanded by sledge hammer/hammer drill, using setting tool, and the diameter and depth of hole is as per anchor.

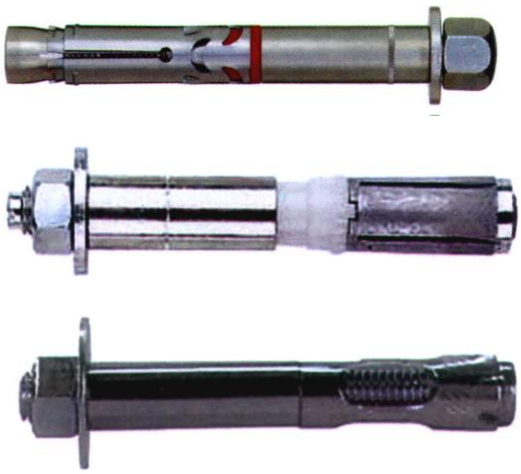
Application example



SLEEVE ANCHOR

It is torque control expansion anchor, consisting of expansion sleeve, bush, distance sleeve (with or without collapsible plastic sleeve), cone and threaded rod with nut and washer. It works on friction mechanism. Its expansion sleeve is specially designed for double expansion i.e. post expansion also in a cracked concrete.

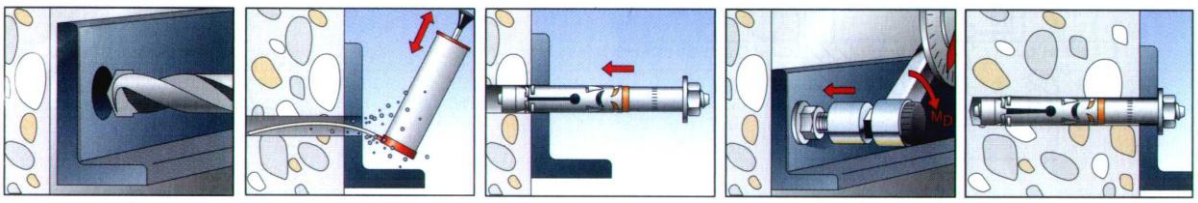
Its double expansion sleeve allows homogeneous and flat distribution of expansion force, thus reduces the edge and axial spacing requirement. Distance sleeve also provides enhanced shear capacity. These anchors are available in following forms.



Suitable for : Concrete (**cracked** and non-cracked) and dense natural stone.

Used for fixing : Steel structure in general, cable tray, bracket, anchor rail, gates, stair case, steel ladder, scaffolding etc. for push through installation.

Installation procedure



For proper fixing, it shall be tightened to a required torque, and washer shall sit firmly against the surface of the attachment.

Application example



ANCHOR BOLT

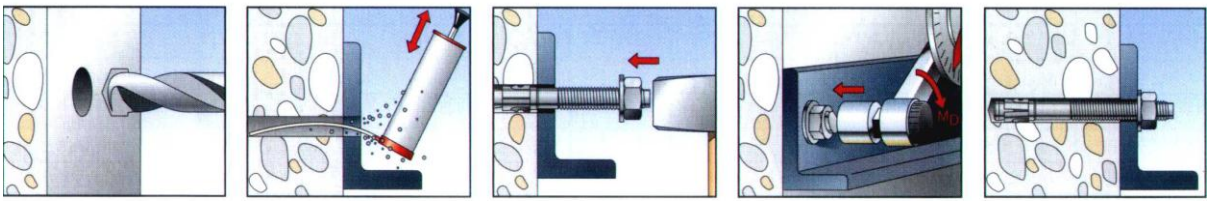
It is a torque controlled expansion anchor consisting of cone bolt, expansion sleeve, nut and washer. It can be installed with variable fixture thickness or anchorage depth, i.e. user has the choice of the standard anchorage depth with max. permissible load and the extended useful length with a reduce permissible load.



Suitable for : Non-cracked concrete and dense natural stone.

Used for fixing : Steel fabrication, metal profile, anchor plate, bracket, window timber construction, beam, purlins, curtain glazing, stone cladding etc.

Installation procedure

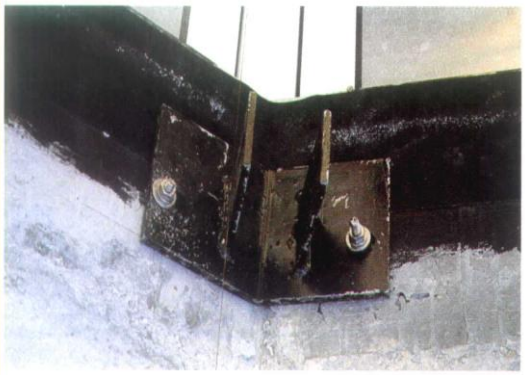


Application examples





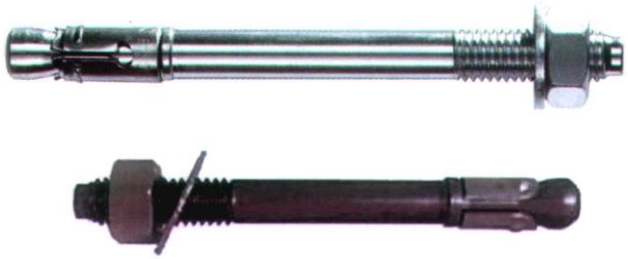




SLEEVE ANCHOR BOLT

It is torque controlled expansion anchor used for push through installation for fixing light to medium load. It consist of expansion sleeve, cone bolt with nut and washer. Its expansion sleeve is specially designed for double expansion i.e. post expansion also in a cracked concrete.

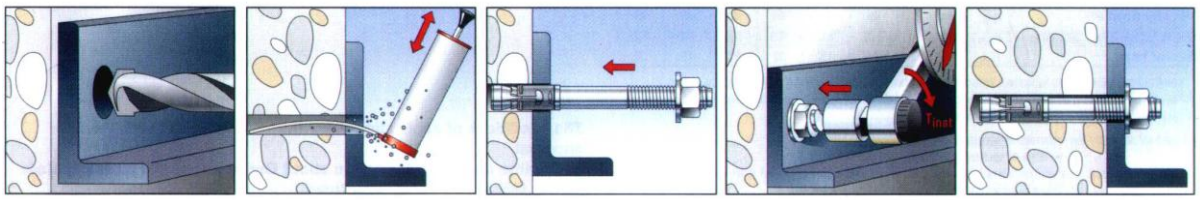
Its double expansion sleeve allows homogeneous and flat distribution of expansion force, thus reduces the edge and axial spacing requirement.



Suitable for : Concrete (**cracked** and non-cracked) and natural dense stone. Its post expansion feature makes it suitable even in cracked concrete.

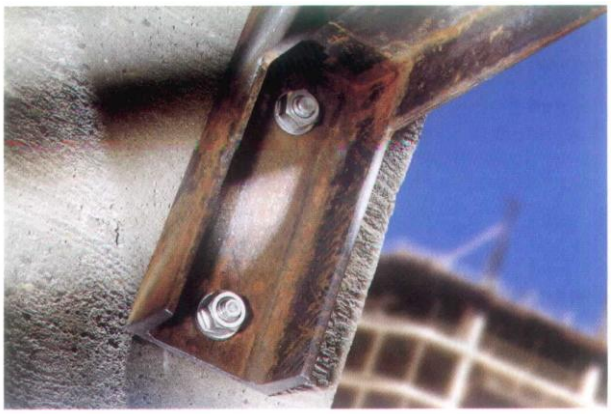
Used for fixing : Railing, handrail support machine, brackets, door, stair cases, ladders etc.

Installation procedure



For proper installation it shall be ensure that it is tightened to the recommended torque and that the washer sits firm against the surface of the attachment.

Application example



HAMMER SET ANCHOR

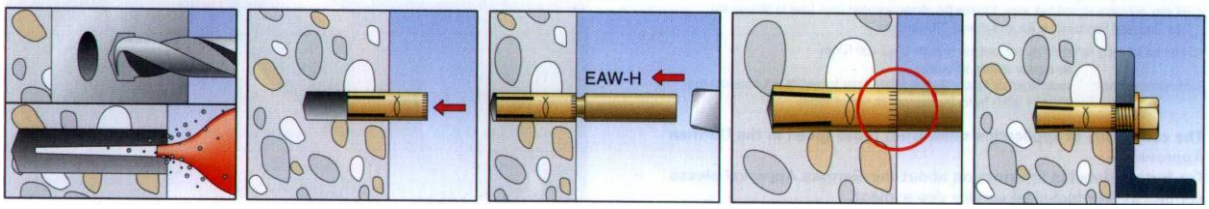
It is a compact internally threaded expansion/ friction fixing for attachment installation. It consists of anchor sleeve with internal thread and cone. On driving the cone, it forms a flush seal with the anchorage sub base. It requires shallow drill hole depth & also permits replacement of the attachment item without influencing the expansion force. Due to high expansion force it requires, more edge distance and axial spacing.



Suitable for : Concrete (**cracked** and non-cracked). Load capacity is up to 11 kN for non-cracked and up to 0.8 kN for cracked concrete.

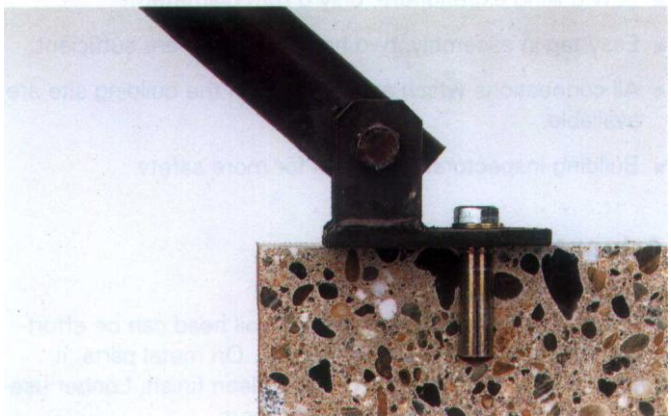
Used for fixing : Flat steel, pipeline, suspended ceiling, assembly support, cladding window, doors, bracket etc.

Installation procedure



For proper installation cone shall be driven with the setting tool till the tool collar lies on the anchor body. Drill hole diameter and depth shall be as per anchor.

Application example



Other applications of high performance anchors





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Go to index

CHAPTER – 6

Chemical fixing

These fixing uses a synthetic resin or epoxy mortar to create a bond with the substrate, which may be either of form locking or bonding type. It is capable of achieving max. grip value in all materials, even problematic ones.

Chemical fixings are available in following types :

- Injection anchor
- Capsule anchor

INJECTION ANCHOR

It consists of styrene free, quick setting, high quality resin mortar and threaded rod with nut & washer or rebar. Mortar is suitable of achieving max. strength in all building material. It is expansion free fixing requiring less edge & axial spacing. In this system the 2 component of the mortar is mixed together in the required proportion inside the static mixture thus permitting multiple use of the cartridge after its opening. It is also available in epoxy mortar type suitable for solid base material.



Suitable for:

Without anchor sleeve - Concrete, solid brick, natural stone etc.

With anchor sleeve - Perforated bricks, hollow blocks, and other perforated material.

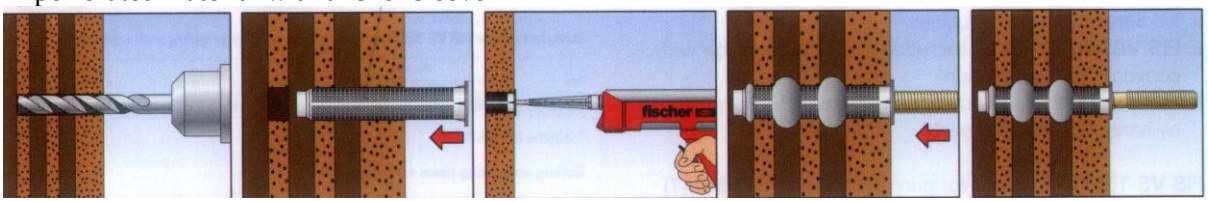
Use for fixing : Machine, gates, brackets, sanitary items and more importantly it is used for post installed rebar connection in concrete structures namely :

i. Extension of cantilever slab
ii. Starter bars for extending concrete column & walls
iii. Starter bars for closing an opening
iv. Anchoring of stair case landing
v. Connection of cantilevered slab to the edge of concrete floor using spliced bars.

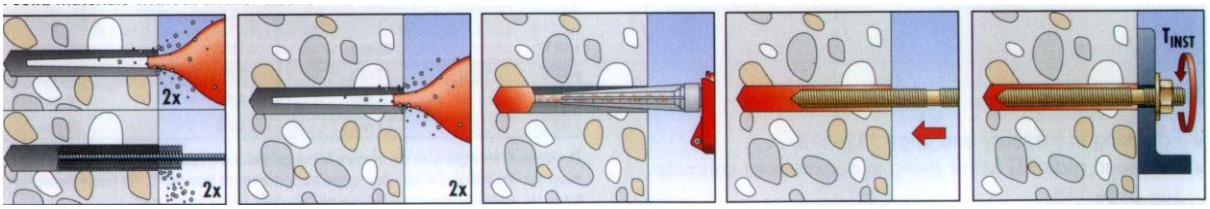
In above application it saves the time and cost compared to the traditional method of break out and making good of the concrete element. It permits flexibility of easy change in use or extension of building.

Installation procedure

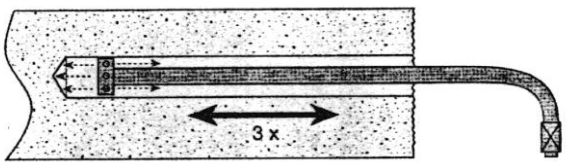
In perforated material with anchor sleeve



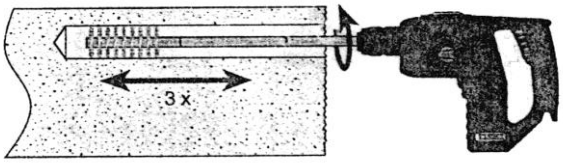
In solid material without anchor sleeve



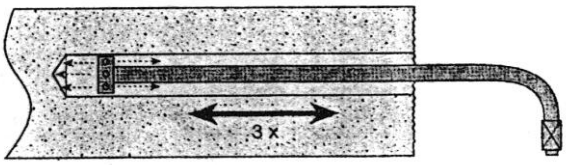
For **rebar** connection :



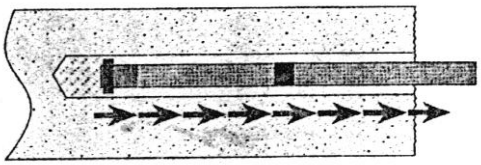
1- Blow cleaning of hole



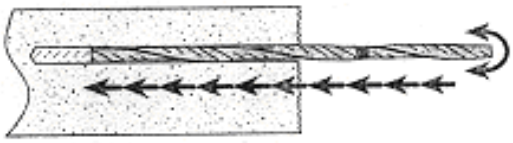
2- Brushing of hole



3- Blow cleaning of hole



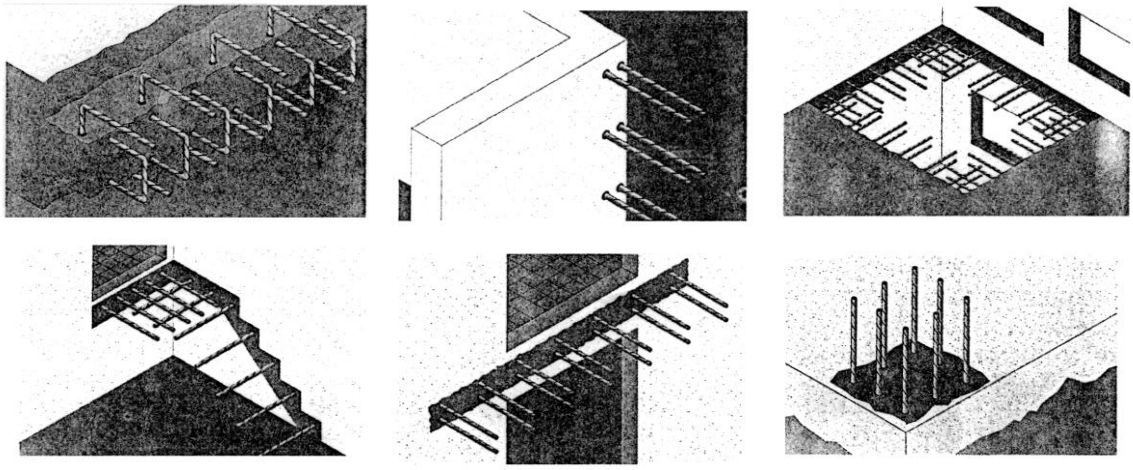
4- Injection of mortar

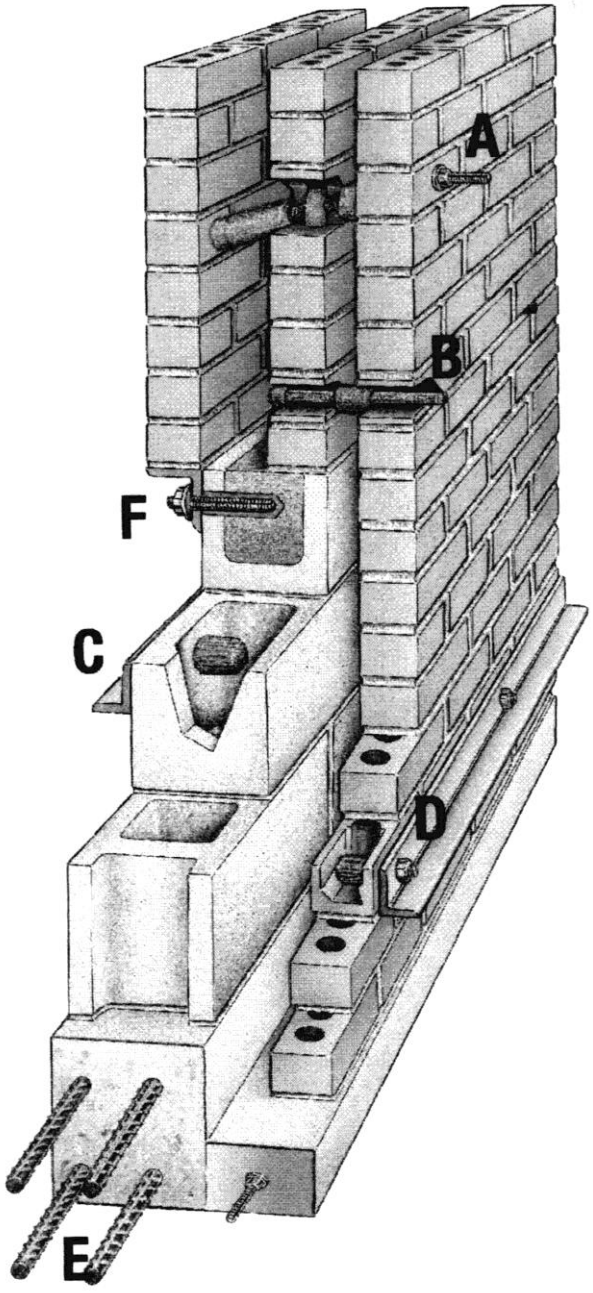


5- Insertion of rebar with simultaneous twisting action

For ensuring proper bonding, component shall be installed/loaded after lapse of recommended setting time.

Application examples





A – **Strengthening of un-reinforced masonry and solid brick masonry for seismic loading.**

B – **Wall pinning using rebar for building renovation.**

C – **Fixing of anchorage to the face of hollow concrete blocks masonry.**

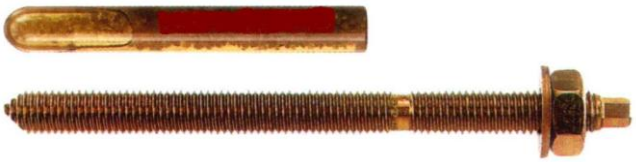
D – **Fixing of anchorage to the face of hollow bricks.**

E- **Rebar doweling into solid concrete.**

F – **Fixing of anchorage in a solidly grouted structural component.**

CAPSULE ANCHOR

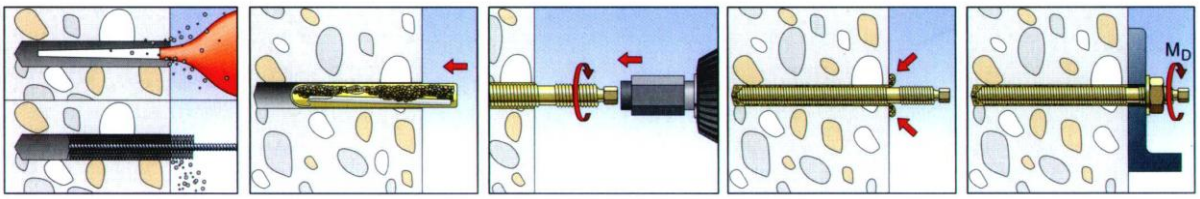
It consists of resin capsule and the threaded rod with washer and nut or internally threaded insert. Capsule is either made of glass or plastic. Instead of rod or insert reinforcement bar can also be used for rebaring purpose. This anchor is free of expansion forces thus requires less axial and edge distance.



Suitable for : Non-crack concrete and natural stone with dense structure for load up to 60 kN.

Used for fixing : Supports consoles window, machine, sign boards, cladding, reinforcement starter bars, steel pillar, lifting barrier post at level crossing etc.

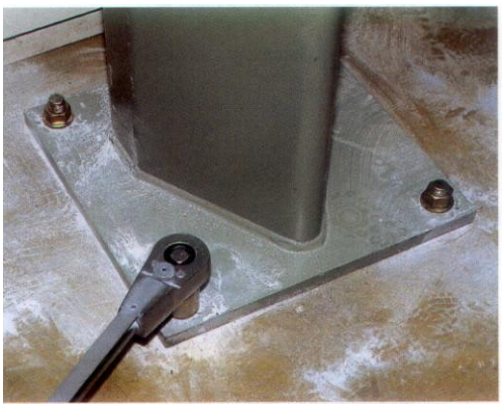
Installation procedure



Application example



Other applications of chemical anchors







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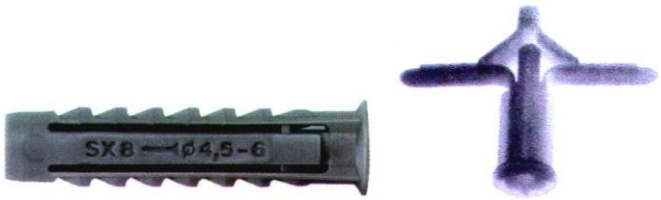
CHAPTER – 7

Cavity fixing

These fixings are used for supporting loads on hollow ceiling, suspended ceiling and hollow walls faced with plaster board, hard board, chip board etc. The supporting element of these fixing which opens up and straddles the board material produces extremely high grip by form locking.

Cavity fixings are available in following forms :

1. **Plastic Cavity fixing :** It is similar to plastic general fixings & carries the component load through form locking by buckling out behind the anchor base.



2. **Plastic toggle fixing :** It is used with wood/chip board screws for fixing curtain rail, lamp and other light weight fixings.

3. **Spring metal toggle :** It is a cavity fixing, which expand automatically in position through spring action.

4. **Gravity metal toggle :** It is cavity fixing, consisting of a toggle bar which locks automatically in the cavities.

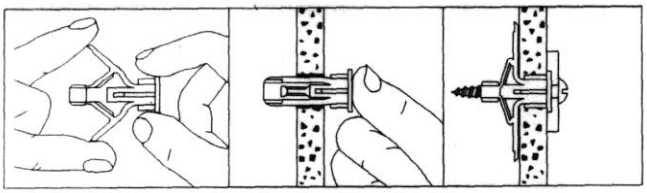


Plastic toggle Spring metal toggle Gravity metal toggle

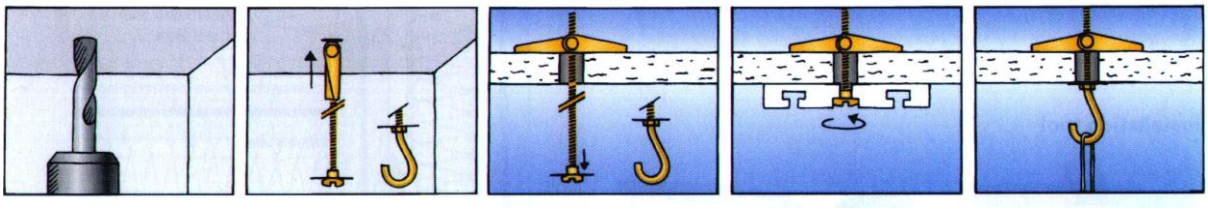
Suitable for : Plaster board, fibre board, chip board, cement board, hard board, perforated brick ceiling, etc.

Used for fixing : Lamps, shelves, skirting boards, walls covers, cable ducts, picture frames, curtain rail etc.

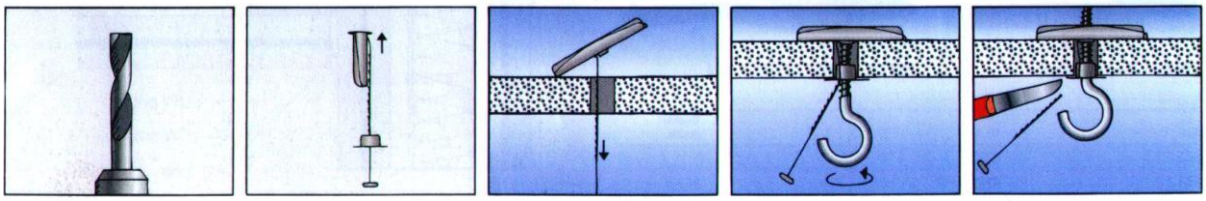
Installation procedure



For plastic cavity fixing

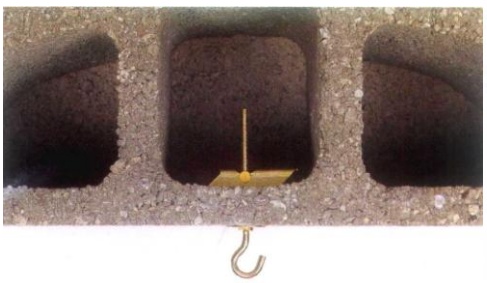


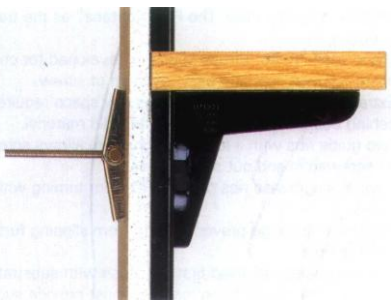
For metal toggles

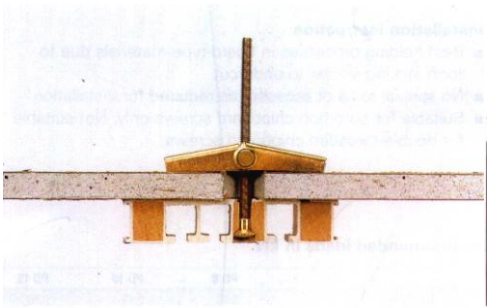


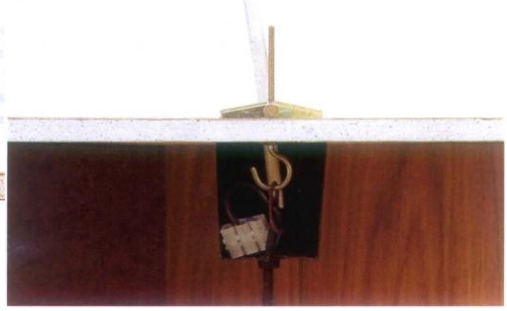
For plastic toggles

Application examples

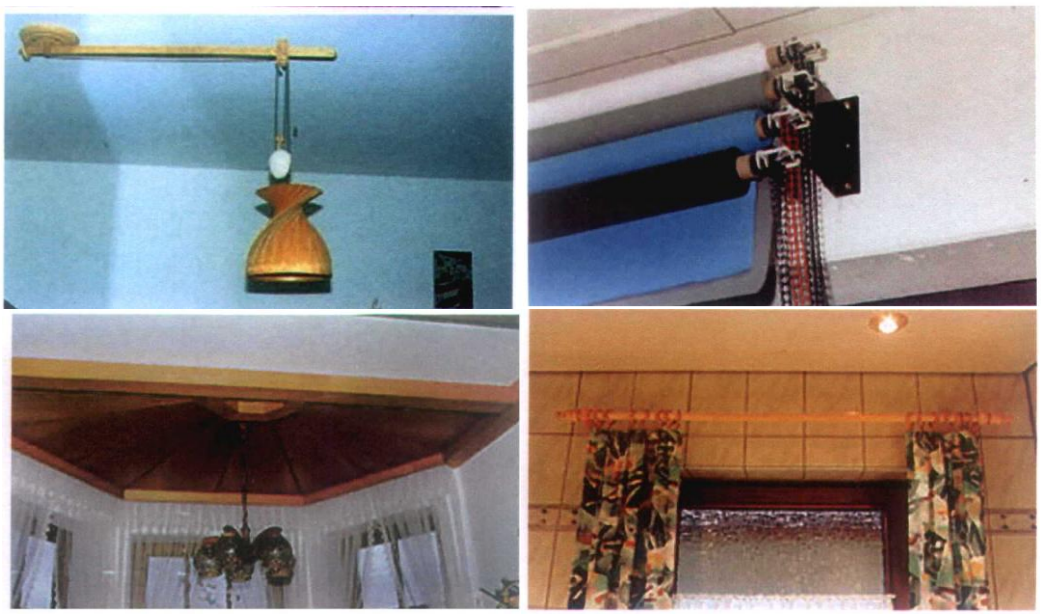








Other applications of cavity fixing



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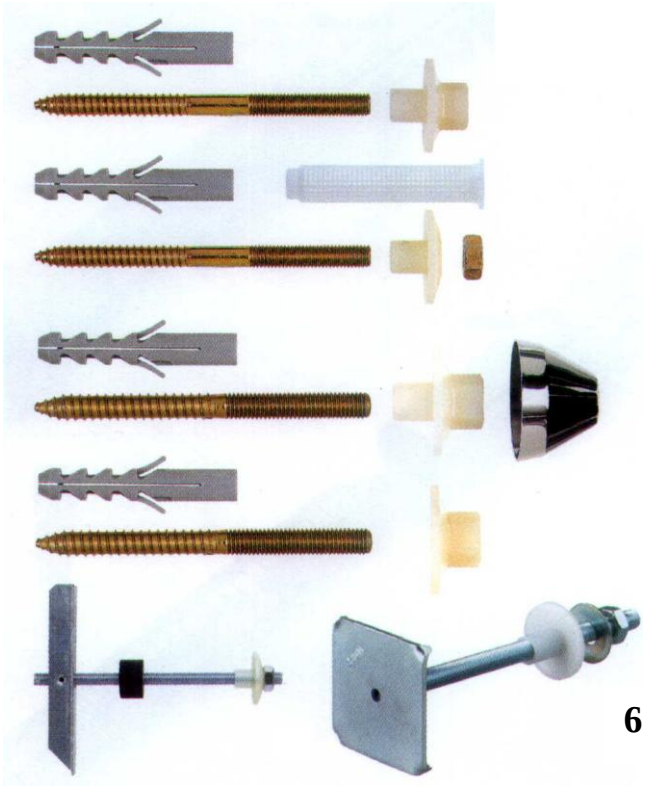
CHAPTER – 8

Sanitary fixing

These fixings are used for installing the sanitary items in the building, i.e. toilet bowl, urinal, wash basins etc. These fixings are available in a complete set consisting of plastic/nylon fixing, screw, bush or flange with nut. These sets are simple in installation and have high holding power, and form elastic joint between the anchor sub base and the ceramic fitting.

As the flange nut or bush is made of nylon, it provides resistance to ageing and chemical reaction, provides elastic fixing compatible with ceramic. These fixing eliminate the requirement of bracket of conventional fixing practice, thus improve the appearance and also permit immediate use after fixing.

These are available in following forms :

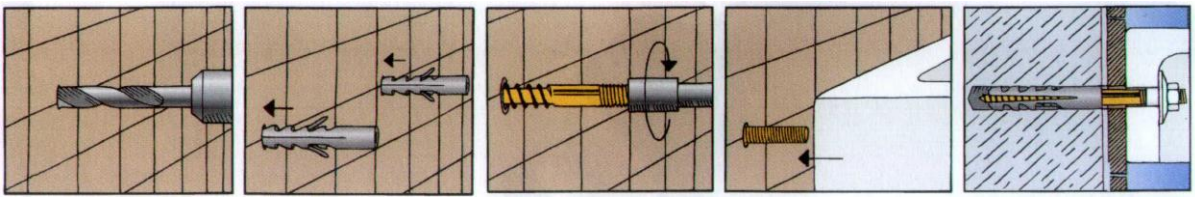


Suitable for : Concrete, natural stone solid bricks, hollow blocks, solid plaster board and aircrete.

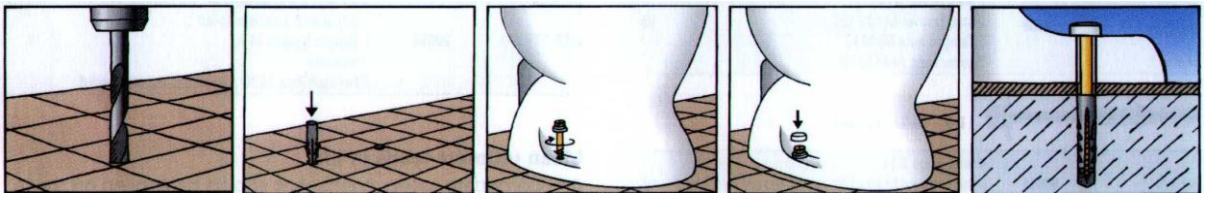
Used for fixing : Various sanitary items.

Installation procedure

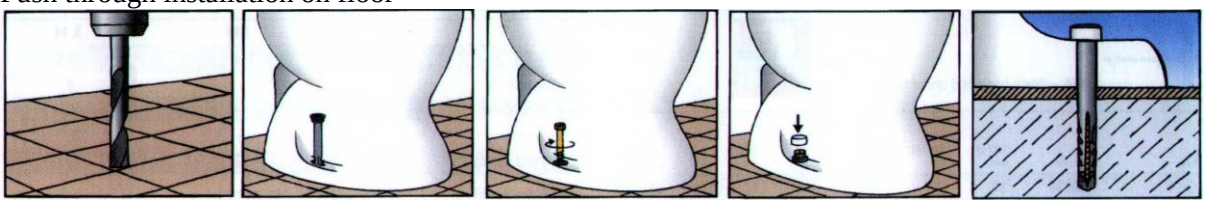
Installation on wall



Attachment installation on floor



Push through installation on floor



Application examples



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Go to index

LIST OF LIKELY SUPPLIERS

1. **Fischer Fixing Systems,**
   Marketed by : Motor Industries Co. Ltd. Power tool Division, Hosur Road, Adugodi, Banglore - 560 030, Tel : 080-299 2138, Fax : 080-221 3706

Regional Offices :

New Delhi	Rishyamook, 85-A, Panchkuin Road, 110001 Tel : 23347591, Fax : 23348264
Mumbai	79, Dr. Anne Besant road, Worli – 400 018 Tel : 022-24980763, Fax : 24954245
Lucknow	4th floor, YMCA Complex, 13 Rana Pratap Marg – 226001 Tel : 0522-2209364, Fax : 2209363
Chennai	Post Box no. 6802, 49, Ethiraj Salai, Egmore – 600 008 Tel : 044-28231946, Fax : 28279355
Indore	Modern mansion, 20/2, South Tukoganj, Mumbai Agra Road – 452001 Tel : 0731-512985, Fax : 0731-512983
Kolkata	Post Box No. : 9044, 91 A, Park Street – 700 016 Tel : 033-22497475, Fax : 22497482
Ahmedabad	31/32, Level 3, JMC House, Ellis Bridge – 380 006 Tel : 079-26420401 Fax : 26420523

2. **Canco Fasteners,**
   Address : M/s. Yen Fasteners, E/218, Shastri Nagar, New Delhi - 110052
   Tel : 011-23655244, 31061155, Mobile : 9810010752 Fax : 23655244

3. **Leo Fasteners,**
   Address : M/s. Rohan International, 3014, Gurdev Nagar, Ludhiana – 141 001
   Tel : 0161-5002781, Mobile : 9417288171, Fax : 0161-2505819

4. **Canon Fasteners,**
   Address : M/s. Canon Fasteners, A-27, Phase – 1, Ashok Vihar, Delhi – 110052
   Tel : 011-23257777, Fax : 23257017

5. **Ferry Fixx Fasteners,**
   Address : M/s. Ferry International, B-253, Naraina Industrial Area, Phase – I, New Delhi – 110028, Tel : 011-251410882, 25790444 Fax : 25790466, 251410881

6. **Hilti Fixing Systems,**
   Address : Hilti India Pvt. Ltd., Sabestian, 8, Local Shopping Center, Pushp Vihar, New Delhi – 110062, Tel : 011-29052836, Fax : 26056530

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NOTES

OUR OBJECTIVE

To upgrade Maintenance Technologies and Methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability, and Utilisation.

If you have any suggestion & comments, please write to us:

Contact person	**:**	**Director (Civil)**
Postal Address	**:**	**Centre for Advanced Maintenance Technology, Maharajpur, Gwalior (M.P.) Pin code – 474 020**
Phone	**:**	**0751 - 2470869, 2470803**
Fax	**:**	**0751 - 2470841**