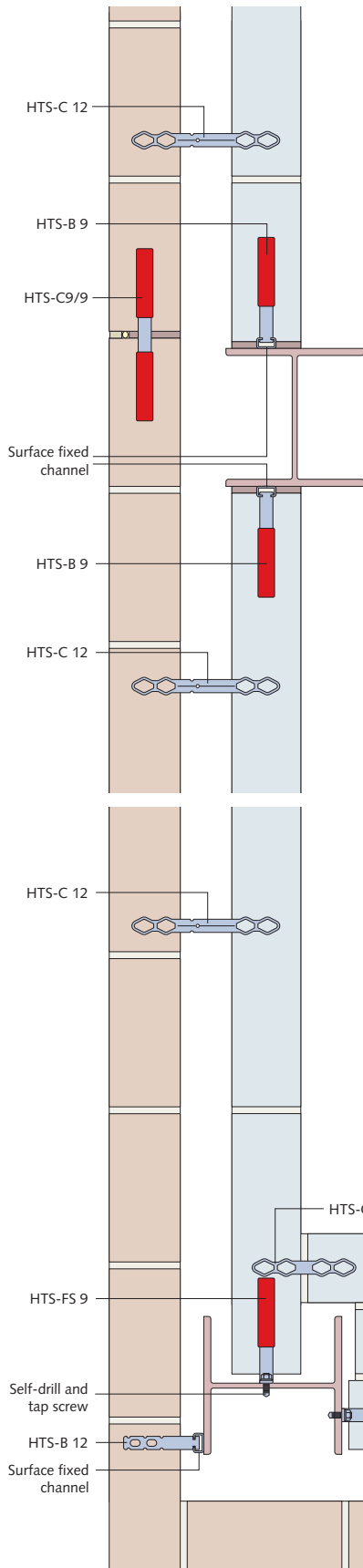


# Brick ties – introduction to standard applications



## Brick ties

Ties are required in brickwork/masonry to provide structural stability and to resist the wind load. Halfen manufacture two ranges:

### HTS system

This consists of a range of standard designs available in standard lengths, ex-stock and suitable for most applications, as shown in these plans:

- ties to suit Halfen channel (both cast-in and surface fixed) are coded HTS-B
- ties to suit normal cavity walls are coded HTS-C
- ties for use as frame cramps, i.e. either screwed or bolted, are coded HTS-FS.

Details of the range and how to specify are given on pages 19-23.

### Made-to-order system

For designs and details where the HTS system is not suitable, for example:

- wider cavities
- greater imposed loads
- special feature panels of masonry

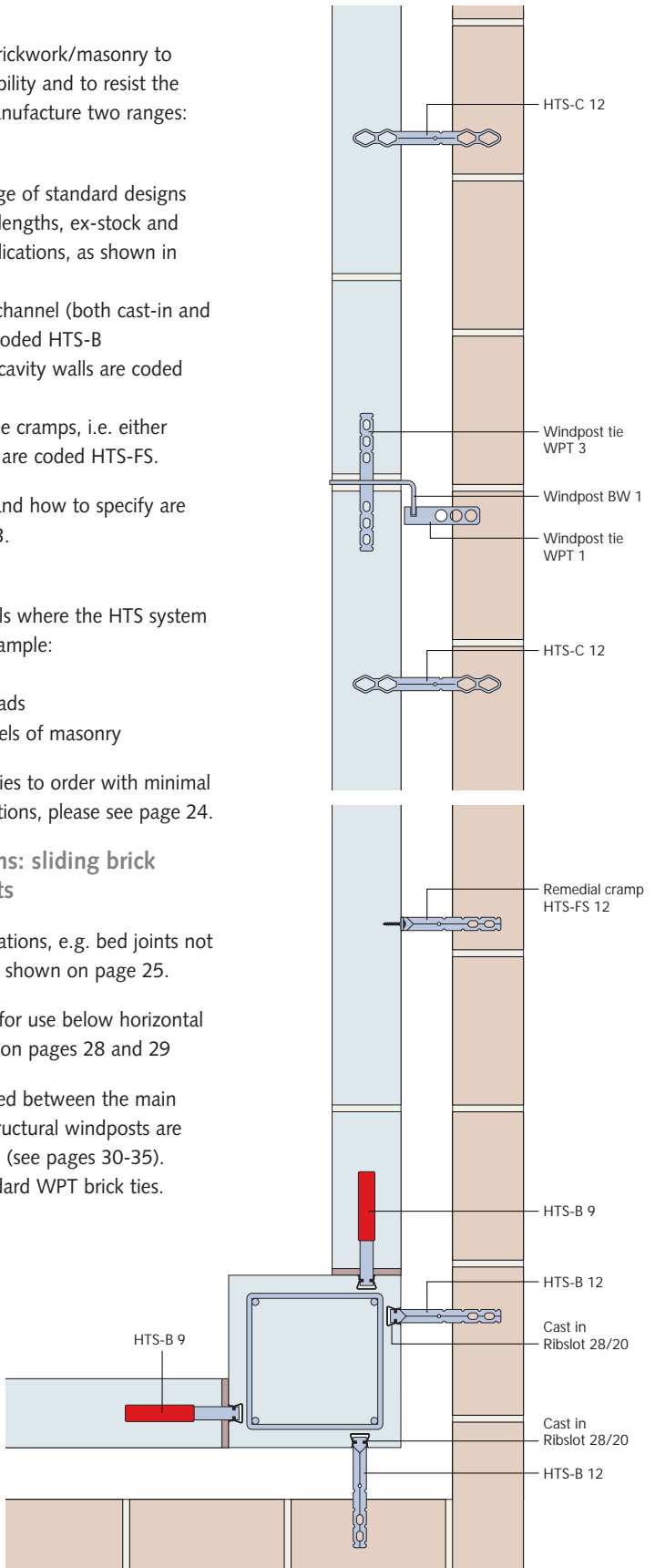
Halfen manufacture ties to order with minimal time and cost implications, please see page 24.

## Special applications: sliding brick anchors; windposts

Ties for special applications, e.g. bed joints not at the same level, are shown on page 25.

Sliding brick anchors for use below horizontal soft joints are shown on pages 28 and 29

Where ties are required between the main building grid, then structural windposts are made to fit by Halfen (see pages 30-35). These posts use standard WPT brick ties.



Note: cavity insulation omitted for clarity

# HTS-B channel ties

Halfen HTS-B channel ties are a standard range designed to bed into the mortar joint at one end, and with a shouldered head that locates into a cast-in or surface-fixed channel at the other end. The head design allows HTS-B ties to locate into Halfen 28/20 Ribslot self-anchoring cast-in channel and also into Halfen 28/15 and 25/17 channels.

HTS-B ties come in standard shapes and lengths, which will cover most applications. However, Halfen also manufacture ties in any shape to order, see page 24.

## HTS-B channel ties

### Description

For shape and dimensions see the adjacent illustrations. The unique 'Λ' shape of the ties imparts extra strength, allowing a reduction in the width of material used over traditional masonry tie design. (Ties for design cavities of 30 mm are flat.)

HTS-B ties locate into Halfen 28/20 Ribslot, 28/15 or 25/17 channels to provide a positive restraint, which meets both tension and compression performance requirements and movement tolerances for masonry/masonry ties.

### Loading

The allowable working load on a tie in channel is 1.5 kN both in tension and compression. This complies with the loads given in DD 140 for a Type 1 tie, although the standard was not written for channel ties. (Channel ties are included in BS EN 845-1). For transverse shear on B 9 ties the allowable load is 1.0 kN.

### Material

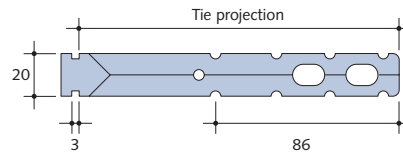
Mild steel: this is normally Grade Z 275 pre-galvanised mild steel (pg). (Hot-dip spun galvanised (hdg) mild steel to BS EN ISO 1461:1999 is also available to special order.) Mild steel ties are for dry internal use only, and must not be used in the outer skin.

Stainless steel: Halfen HTS-B ties are normally manufactured from Grade 304 stainless steel (S304). Grade 316 stainless steel (S316) is also available to special order.

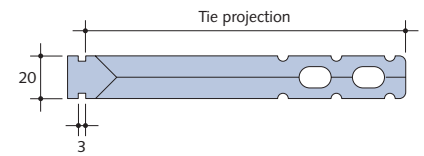
### De-bond ties

Plain shank HTS-B ties with or without plastic sleeves are available for shear load applications.

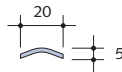
### HTS-B channel tie dimensions



Stainless steel HTS-B channel tie with drip feature



Galvanised HTS-B channel tie for dry internal use

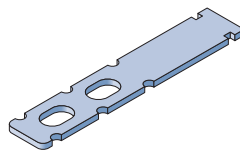


### Material thickness

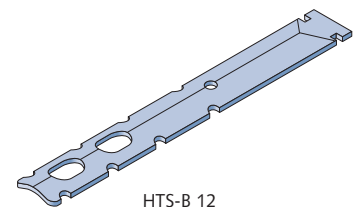
All ties Code HTS-B are 2.0 mm thick

HTS-B standard lengths (to suit cavity widths*) (mm)			
75	(0-20)	100	(10-45)
125	(35-70)	150	(60-95)
175	(85-120)	200	(110-145)

\* Min-max. cavity based on min. 50 mm embedment and max. 85 mm embedment. (Halfen recommend a design embedment of 70 mm.) Select ties to allow for building tolerances.

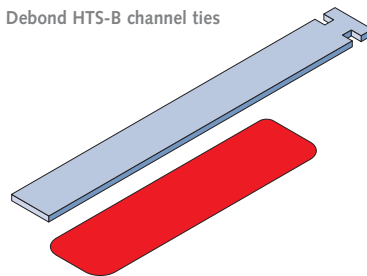


HTS-B 12  
(flat for narrow cavities)  
Projections: 75 and 100 mm



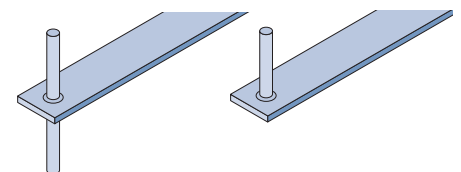
HTS-B 12  
('Λ' shape)  
Projections: 125, 150, 175 and 200 mm

### Debond HTS-B channel ties



HTS-B 9 plain end for de-bond  
HTS-B 9 PS plain end with plastic sleeve  
Projections: 150, and 200 mm  
(other projections to order)  
Plastic sleeves: 150 or 200 mm long

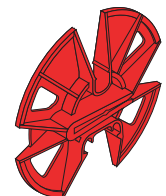
### Ties with dowels



For plain end ties with a dowel, see made-to-order ties, page 24.

### Insulation disc

Insulation-retaining disc suitable for all HTS ties.  
Code : FL disc



### How to specify HTS-B channel ties

HTS Code	B For channel	9 Bond/de-bond	ss Material	150 Projection (mm)	DISC Accessories
----------	---------------	----------------	-------------	---------------------	------------------

### Abbreviations

Bond/de-bond	Material	Accessories
9 de-bond from mortar	ss stainless steel	DISC plastic insulation-retaining disc
12 bond to mortar	pg pre-galvanised	PS plastic sleeve to assist de-bond

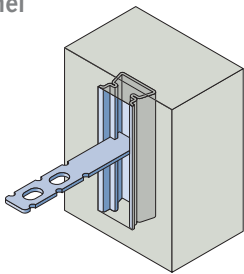
# Channels for HTS-B ties

The channel profiles shown on these pages are for use with HTS-B brick ties (see page 19) and are either cast into concrete or surface-fixed.

## Cast-in channels

Normally the cast-in channel is the economical, self-anchoring 28/20 Ribslot. (Heavy channel 28/15 HTA can be cast in, if required.)

### Halfen 28/20 Ribslot self-anchoring channel

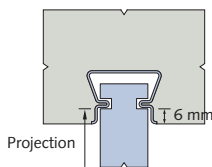


The profile of the Halfen 28/20 Ribslot self-anchoring channel has been designed to achieve minimal deflections when cast into concrete, and high load capacity using a minimal profile section.

#### Materials

Halfen 28/20 Ribslot brick tie channel is available in Grade 304 stainless steel (S304) and pre-galvanised carbon steel (pg) with a Grade Z 275 coating. Grade 316 stainless steel (S316) is also available subject to quantity.

#### Dimensions



Ribslot 28/20 shown cast into concrete. (28/20 must not be surface-fixed.) (Note: actual projection of tie is reduced by 6 mm)

How to specify Ribslot		
28/20 Ribslot	ss	3050
Code	Material	Length (mm)

Standard lengths

28/20 Ribslot - 100, 150 and 3050 mm

Materials

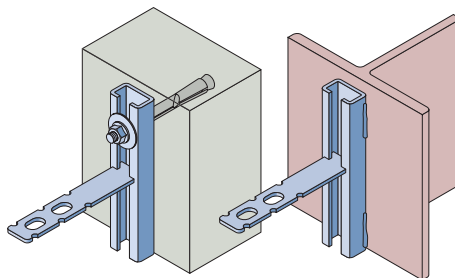
ss stainless steel

pg pre-galvanised

## Surface-fixed channels

In concrete structures surface-fixed channel should be avoided as far as possible. However, for steel and timber, or for refurbishment of existing structures, surface-fix channel 28/15 is available. (Halfen 28/20 Ribslot cannot be surface-fixed.)

### Halfen 28/15 surface-fixed channels

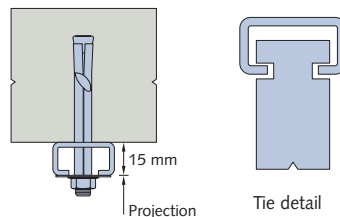


This has a heavy profile in comparison with 28/20, and is normally used where the brick tie channel is to be surface-fixed. Channel 28/15 is finished in various ways:

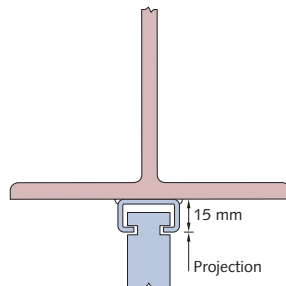
**Code HM** plain rolled profile, usually fixed by welding.

**Code HL** factory-slotted for fixing. The slots are 9 x 25 mm at 40 mm centres. Fixing is usually by M8 bolts, studding or SEB sleeve anchors.

#### Dimensions



Channel type 28/15 HL fixed to existing concrete or brickwork with SEB 8 sleeve anchor.



Channel type 28/15 HM fixed to steel with fillet welds both sides. Typically welds 30 mm long at 400 mm centres.

#### 28/15 Materials

The materials available for 28/15 channel are:

- carbon steel mill finish
- carbon steel hot-dip galvanised
- stainless steel Grade 304 (S304)
- (stainless steel Grade 316 (S316) is available to order).

#### Channel length/fixing centres

Channel can be used in short lengths set out to suit or in continuous lengths. Short lengths are typically 150 mm long and fixed at 100 mm centres. Continuous lengths can be up to 3 m long and are typically fixed 50 mm from each end and at up to 400 mm centres

#### General note

When 28/20 Ribslot is used to restrain the outer skin, it must always be stainless. In some cases hdg 28/15 may be suitable for the outer skin, when used with stainless steel ties. Please consult Halfen Limited. (Channel 28/15 is a strong profile and also takes Halfen T-head bolts).

How to specify surface-fixed brick tie channels		
28/15 HL	ss	3000
Code	Material	Length (mm)

Available lengths

28/15 HL Pre-slotted - any length up to 6 m (hdg/ss)

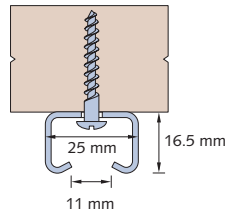
28/15 HM Plain back - any length up to 6 m (hdg/ss)

28/15 HTA Channel with anchors - any length up to 6 m (hdg/ss)

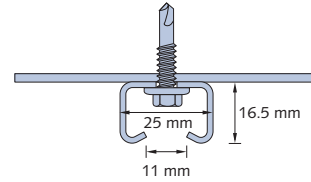
28/15 HTA-F Channel for mortar bed - 75, 100 and 150 mm (see page 25) (ss)

## Halfen 25/17 HH surface-fixed channel

Channel 25/17 HH is a new economical brick tie channel, pre-punched with holes for surface fixing with screws. It is made in grade 304 stainless steel and is available in 3.0 m lengths, i.e. it is used in continuous lengths. Holes are 5.5 mm diameter for 5.0 mm screws. Holes are spaced at 112.5 mm centres.

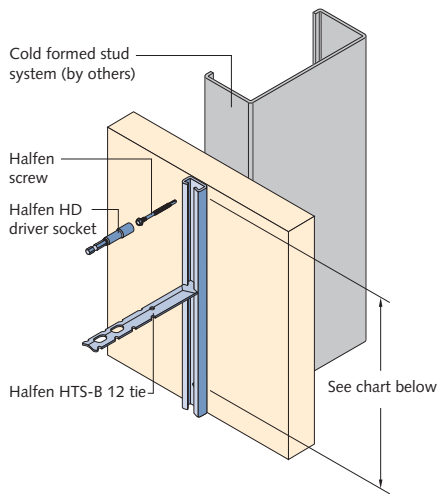


Channel type 25/17 HH fixed to existing brickwork/timber etc with screws

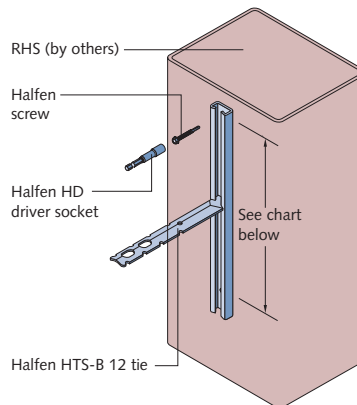


Channel type 25/17 HH fixed direct to steel stud using Halfen self-drill and tap screws

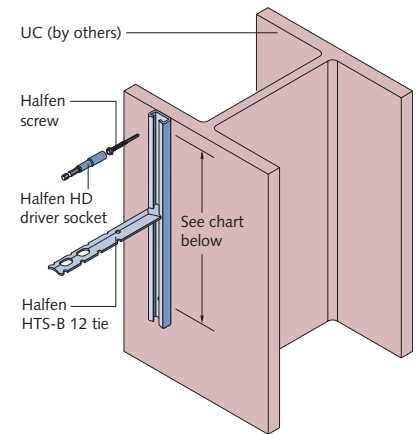
### Halfen 25/17 HH channel self-drill and tap fixings



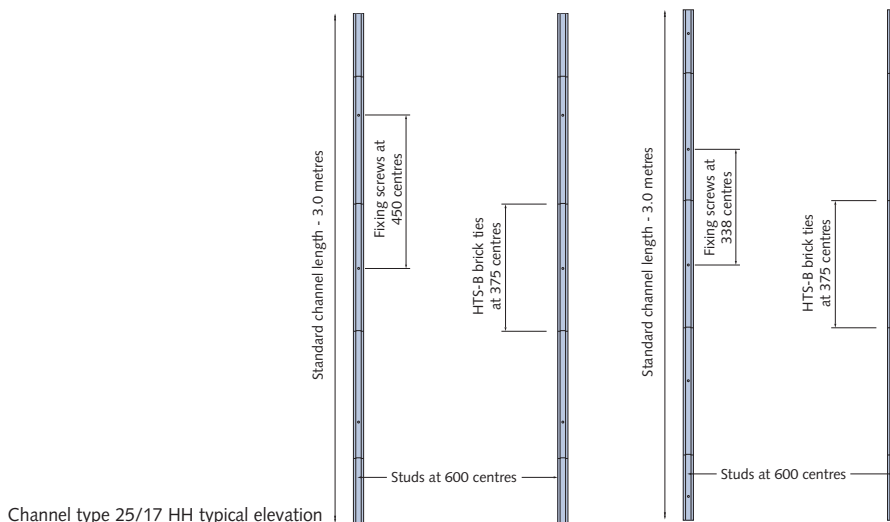
Channel type 25/17 HH fixed through 25 to 40 mm thick insulation. Screw details see page 26.



Channel type 25/17 HH fixed with Halfen self-drill and tap screws. Screw details see page 26.



Channel type 25/17 HH fixed with Halfen self-drill and tap screws. Screw details see page 26.



Channel type 25/17 HH typical elevation

	Standard specification	High load specification
Vertical channel - horizontal spacing	600 mm	600 mm
Fixings - vertical spacing	450 mm	338 mm
Ties - vertical spacing	375 mm	375 mm
Allowable load per tie tension or compression	0.5 kN	0.7 kN

For full wind load details please consult Halfen.

### Cutting on site

Standard 3.0 m lengths may be cut on site, in which case the standard fixings are:

Cut length 1.0 m	4 No. screws
Cut lengths 400 to 900 mm	3 No. screws
Cut lengths 150 to 400 mm	2 No. screws

# Brick ties – HTS-C cavity ties

Halfen HTS-C cavity ties have been designed to meet the design and performance requirements of DD 140. These ties are designed for a normal 10 mm mortar bed; for a thin bed, please consult Halfen Limited.

HTS-C ties come in standard shapes and lengths, which will cover most applications. However, Halfen also manufacture ties in any shape to order, see page 24.

## Description

For shape and dimensions see the adjacent illustrations. Halfen ties are designed to have no sharp edges likely to cause injury, in line with Health and Safety guidelines. The unique 'Λ' shape of the ties imparts extra strength, allowing economical use of material.

### Material

**Mild steel:** this is normally Grade Z 275 pre-galvanised mild steel (pg). Hot-dip spun galvanised (hdg) mild steel to BS EN 1461: 1999 is also available to special order. Mild steel ties are for dry internal use only, and must not be used in the outer skin.

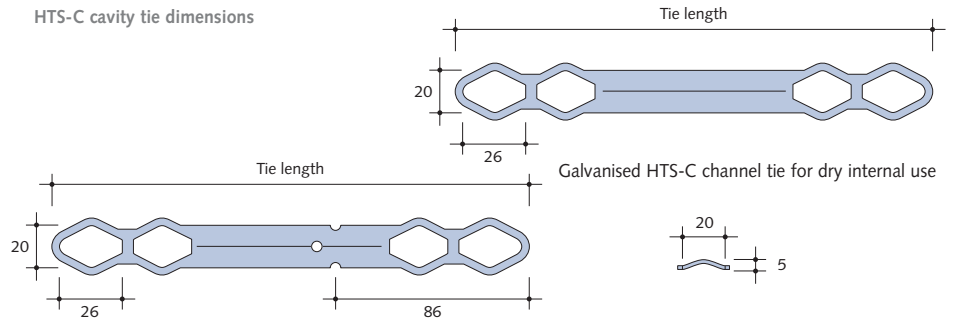
**Stainless steel:** Halfen HTS-C ties are normally manufactured from Grade 304 stainless steel (S304). Grade 316 stainless steel (S316) is also available to special order.

HTS-W wire ties are available in stainless steel Grade 304 only.

### Loading

The allowable working load on a tie is 1.5 kN both in tension and compression. This complies with DD 140 Type 1. For transverse shear on C 9 ties the allowable load is 1.0 kN.

HTS-C cavity tie dimensions



Stainless steel HTS-C channel tie with drip feature

### Material thickness

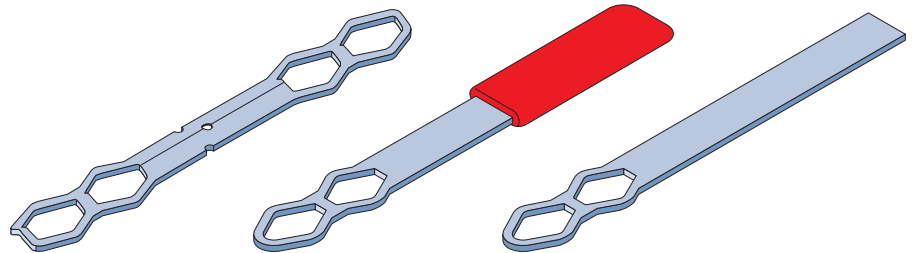
Standard tie lengths 150 to 250 mm: 1.5 mm thick  
Standard tie lengths >250 mm: 2.0 mm thick

HTS-C standard lengths (to suit cavity widths\*) (mm)

150	(0-50)	200	(30-100)
225	(55-125)	250	(80-150)
300	(130-200)		

\* Min-max. cavity based on min. 50 mm embedment and max. 85 mm embedment. (Halfen recommend a design embedment of 70 mm.) Note: DD 140 data is applicable to cavities up to and including 100 mm only.

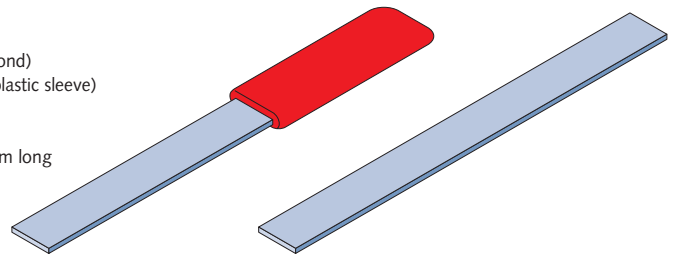
HTS-C masonry/masonry ties



HTS-C 12  
DD 140: Type 1 tie  
For lengths, see table.  
(150 mm stainless steel tie has no drip feature.)

HTS-C 12/9 plain end for de-bond  
HTS-C 12/9 PS plain end and plastic sleeve  
DD 140: n/a  
Length: 250 mm  
Plastic sleeve: 150 and 200 mm long

HTS-C 9/9 (plain end for de-bond)  
HTS-C 9/9 PS (plain end and plastic sleeve)  
DD 140: n/a  
Length: 300 mm  
Plastic sleeves: 150 and 200 mm long



Halfen Masonry/Masonry Ties – suggested Working Loads after applying a Safety Factor of 3 in designation [i] mortar (in designation [iv] mortar)

Tie code	Tension (kN)	Compression (kN)	Shear* (kN)
HTS-C 12	1.5 (0.75)	1.5 (0.75)	1.5 (0.75)
HTS-W2	0.6 (0.6)	0.45 (0.45)	1.0 (1.0)

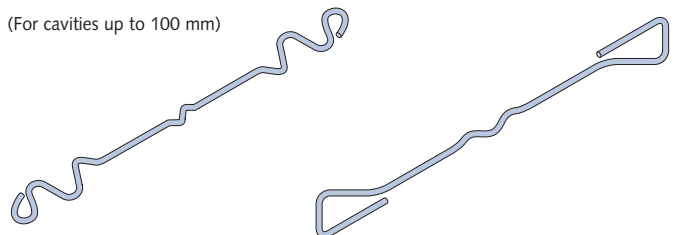
\* Assuming closely abutting surfaces, i.e. maximum gap 15 mm. The figures quoted are for guidance only; the Halfen Technical Department will advise on specific requirements.

### How to specify HTS-C cavity ties

HTS Code	C	12	ss	225	DISC
	For 2 skins of masonry	Bond/de-bond	Material	Length (mm)	Accessories

### Wire ties

(For cavities up to 100 mm)



HTS-W2  
DD 140: Type 2  
Wire diameter: W2 = 3.0 mm, W4 = 2.6 mm  
Lengths: 200 mm, 225 mm  
Material: stainless steel Grade 304

HTS-W4  
DD 140: Type 4

# Brick ties – HTS-FS frame cramps

Halfen HTS-FS frame cramps are ties that bed into the mortar joint at one end and are surface-fixed to the structure through an upstand at the other end.

HTS-FS frame cramps come in standard shapes and lengths, which will cover most applications. However, Halfen also manufacture frame cramps in any shape to order, see page 24.

## Description

### Material

**Mild steel:** this is normally Grade Z 275 pre-galvanised mild steel (pg). Hot-dip spun galvanised (hdg) mild steel to BS EN 1461: 1999 is also available to special order. Mild steel ties are for dry internal use only, and must not be used in the outer skin.

**Stainless steel:** Halfen HTS-FS frame cramps are normally manufactured from stainless steel Grade 304 (S304). Stainless steel Grade 316 (S316) is also available to special order.

### Applications

Frame cramps are widely used to fix new brick/blockwork to existing substrates, or as a remedial (post-fixed) solution where ties have corroded or have been omitted during original construction.

## Recommended fixings

The recommended fixing is dependent on the substrate and its condition.

**Timber:** nails or wood screws are normally specified by others.

**Brick/blockwork:** one SEB 8 sleeve anchor and oversized washer, one No 12 screw and oversized washer into nylon plug.

**Concrete/brickwork:** one MVA 8 resin anchor plus capsule and oversized washer, or one SEB sleeve anchor and oversized washer.

**Steel:** see page 26 for self drill and tap screw.

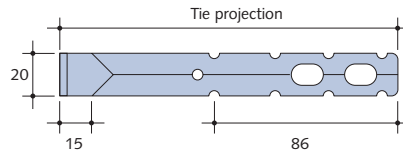
### Washers

Oversize washers must be used, to support the vertical leg and to resist tensile loads.

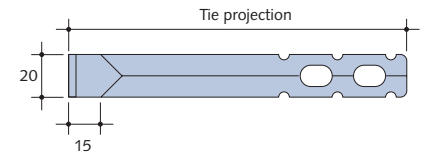
### Loading

The allowable working load on a tie is 1.0 kN both in tension, compression and transverse shear. To achieve this, a plate washer must be used with a suitable fixing, and for soft joints using Type 9 ties the soft material gap must be not greater than 15 mm.

### HTS-FS frame cramp dimensions



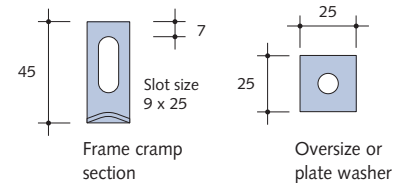
Stainless steel HTS-FS frame cramp with drip feature



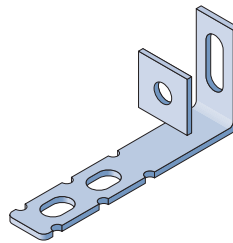
Galvanised HTS-FS frame cramp for dry internal use

### Material thickness

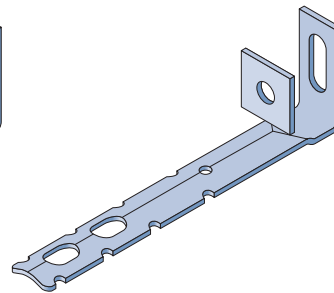
Standard tie lengths 75 to 200 mm: 2.0 mm thick



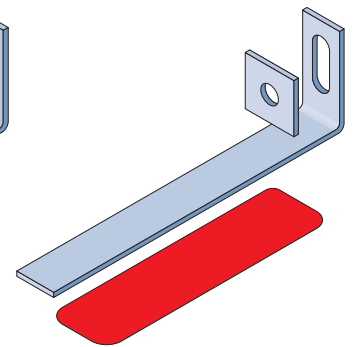
### HTS-FS frame cramps



HTS-FS 12 (flat for narrow cavities)  
Lengths: 75 and 100 mm

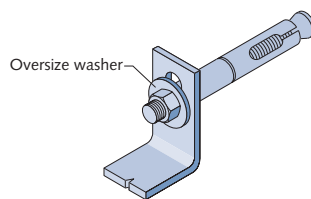


HTS-FS 12 ('^' shape)  
Lengths: 125, 150, 175 and 200 mm

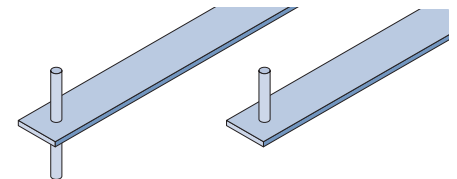


HTS-FS 9 plain end for de-bond  
HTS-FS 9 PS plain end and plastic sleeve  
Lengths: 150 and 200 mm

### Typical fixing to existing masonry or concrete



SEB 8 sleeve anchor complete with standard oversized washer



For plain end frame cramps with a dowel, see made-to-order ties, page 24.

### How to specify HTS-FS frame cramps

HTS Code	FS Bolt/screw	12 Bond/de-bond	ss Material	150 Projection (mm)	DISC Accessories
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### Abbreviations

Bond/de-bond	Material	Accessories
9 de-bond from mortar	ss stainless steel	DISC plastic insulation-retaining disc
12 bond to mortar	pg pre-galvanised	PS plastic sleeve to assist de-bond

# Ties made to order

## How to specify: code system

The ties described on pages 18 to 23 cover most requirements. However, where ties need to be of a special shape or length, the codes shown below can be used to specify any shape to order. (These ties are made on standard tooling, so do not normally incur time or cost penalties.)

## Material

All ties are normally manufactured out of 25 x 2.5 mm stainless steel. (25 x 3 and 30 x 3 mm sizes are available to order.)

### Choice of fixing to the structure

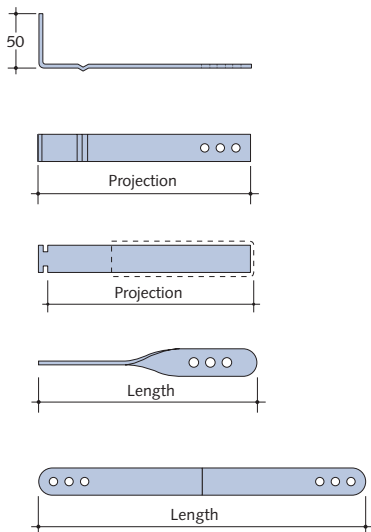
FS		Once bent, with slot for bolt or screw
FH		Once bent, with hole for bolt or screw
B		Shouldered for Halfen channel 28
KT		Shouldered for Halfen channel 38
G		Holes for bolt or screws; can be fixed to slab or column

### Choice of design across the cavity

D		Vee drip
P		Plain
HT		Half-twist
FT		Full-twist
VT		Vertical twist

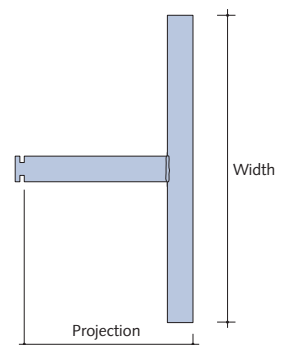
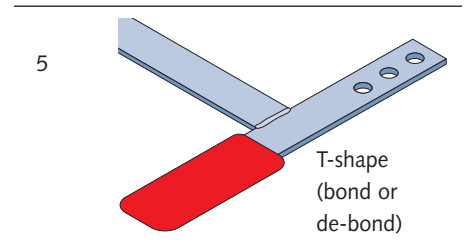
### Choice of design in the mortar bed

12		Bonding holes safety end
9		Plain end (De-bond sleeve optional extra, code PS)
8		Hole (for 2-way loose dowel)
7		Fixed one-way dowel (Loose one-way dowel optional)
6		Multi-hole for dowel, bolts or screws
14		Wire



Typical order codes					
Fixing to structure	Design at cavity	Design in mortar bed	Projection/length (mm)	Width (mm)	Bond/de-bond
FS	D	12	180		
KT	P	9	200		
G	HT	12	300		
12	D	12	350		
B	P	5	150	225	9

9 = de-bond  
12 = bond  
PS = sleeve



# Specialist ties

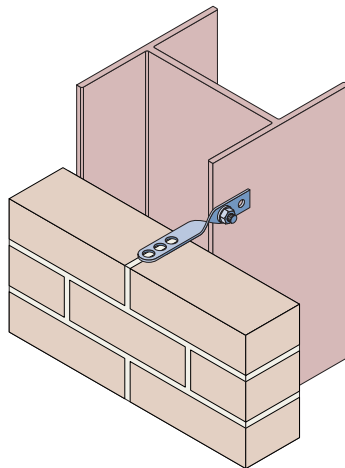
## 'Fast track' ties

Halfen 'fast track' ties (coded 28/15 HTA-F), built into the inner leaf, provide a means of restraint that allows for variations in course height, and eliminates the hazard created by building-in conventional ties with large projections in readiness for completion of the outer leaf.

The Halfen 'fast track' tie is available with a 75 mm long anchor as standard for flush fitting. The channel length is normally 75, 100 or 150 mm.

## Fixing to steelwork

The Halfen G HT 12 half-twist restraint ties are specifically designed to allow masonry to be restrained back to steelwork, as illustrated. The ties have two alternative holes for fixing to the steelwork, and either a holed end for building into brick joints or a doweled end for restraining stone. The ties are 200 mm long overall and are suitable for cavities from 50 mm to 100 mm wide. For larger cavities please consult Halfen.



Half-twist tie  
Bolted or screwed to steelwork G HT 12

## Halfen brickwork/steel flange tie

The Halfen flange tie, Code HTS-16, is an economical method of restraining brick and blockwork to steel columns. Built in by the bricklayer as work proceeds, the ties are simply hooked onto flanges to provide restraint.

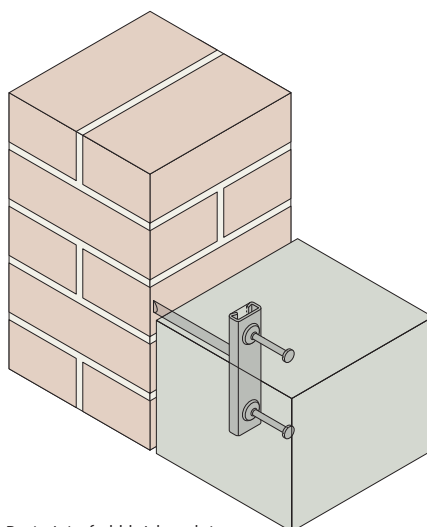
Flange ties are manufactured from 2 mm stainless steel Grade 304, with cut-outs to suit steel flanges from 6.8 to 17.3 mm.

## Restraining old brickwork

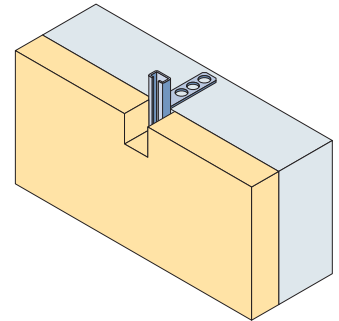
To tie old facades to new concrete floors, the detail shown using vertical cast-in channel allows differential movement, but provides strong restraint. The threaded stud bonded into the wall with resin is held in the channel by means of a captive locking plate.

## Thin bed ties

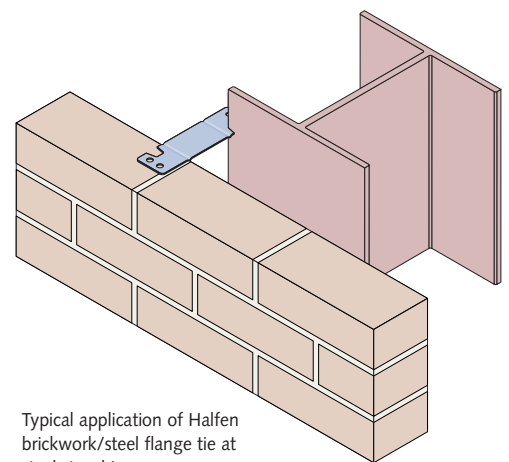
Ties are manufactured in 1.2 mm stainless steel for thin bed details. For further information, please consult Halfen Limited.



Restraint of old brickwork to  
new concrete floor slab



Channel 28/15 for building into bed joints  
28/15 HTA-F used with the HTS-B tie system  
(For order code details, see page 20.)



Typical application of Halfen  
brickwork/steel flange tie at  
steel stanchion

# Halfen self-drill and tap screws

## Fastener details

This page gives specification data and guidance on the use of Halfen self-drill and tap screws. These can be used with the Halfen range of channel, brick ties and restraint products, which are increasingly used in the dry-lining and brick laying trades. For details, see page 21. Screws are available to suit either tight fit or spaced off applications and in carbon steel or stainless steel.

Code HDT denotes carbon steel with a BZP finish.

Code HSD denotes stainless steel material (may have carbon steel cutting tip).

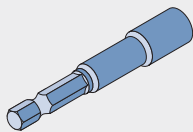
These screws are available plain or with a factory-fitted washer.

Pull-out loads per screw (fixed to cold rolled profiles)				
Profile thickness (mm):	1.2	1.6	2.0	3.0
Ultimate load (kN):	2.1	2.7	4.3	6.5
Recommended allowable working load (kN):	0.7	0.9	1.4	2.2

Notes: Carbon steel BZP should not be used in aggressive environments. Carbon steel finished zinc rich (code EV) is available for a longer life. Alternative applications and other screw lengths are available. For details of all the above, please consult Halfen.

### HD Driver

Specially made to fit through the lips of Halfen 25/17 HH channel.



### Fixing tight to substrate

Types HDT4 and HSD4 are used to fix Halfen channel or ties/frame cramps to light steel section support structures, i.e. steel studs up to 4 mm thick.

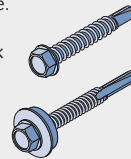
Types HDT12 and HSD12 are used to fix to heavier section steel up to 12 mm thick.

#### HDT (BZP) and HSD (SS) self-drill and tap screws

For use when fixing tight to substrate.

Type 4 steel < 4 mm thick and  
Type 12 steel > 4 mm < 12 mm thick

For factory-fitted washers use the  
suffix codes G16 (BZP) or  
S16 (stainless).



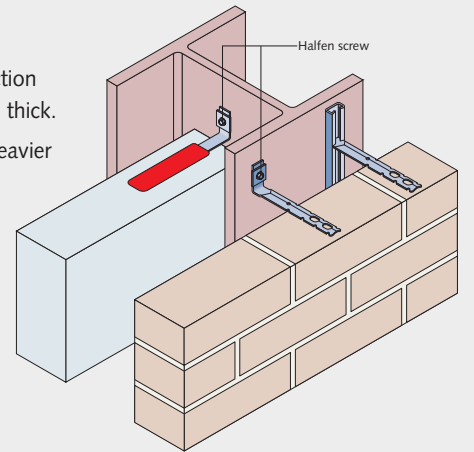
Specification: 25/17 HH or frame cramps  
steel structure thickness < 4 mm

BZP screw code HDT 4 x 35, SS screw code HSD 4 x 38

steel structure thickness > 4 mm < 12 mm

BZP screw code HDT 12 x 40, SS screw code HSD 12 x 40

Frame cramps are normally fixed using screws with factory-fitted washers, code S16 (BZP) or G16 (SS), but plate washers are also essential as shown.

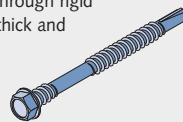


### Spaced off fixings

Types HDTHT and HSDTHT are for use spaced off through rigid insulation, to fix Halfen channel to light steel structures, i.e. steel studs up to 4 mm thick.

#### HD THT (BZP) and HSD THT (SS) self-drill and tap screws

For use with spaced off fixing through rigid  
insulation board 25 to 40 mm thick and  
steel < 4 mm thick.



Specification: Channel 25/17 HH fixed through rigid insulation  
25 to 40 mm thick

steel structure thickness < 4 mm

BZP screw code HD THT x 65, Stainless screw code HSD THT x 70

Cold formed stud  
system (by others)

Halfen  
screw

Halfen HD  
driver socket

Halfen HTS-B 12 tie

Normal max.  
338 mm centres  
see page 21

Halfen Channel type 25/17 HH  
pre-pierced at 112.5 mm centres  
with 5.5 mm diameter holes, and  
fixed through 25 to 40 mm thick  
insulation.

## Sliding brick anchors

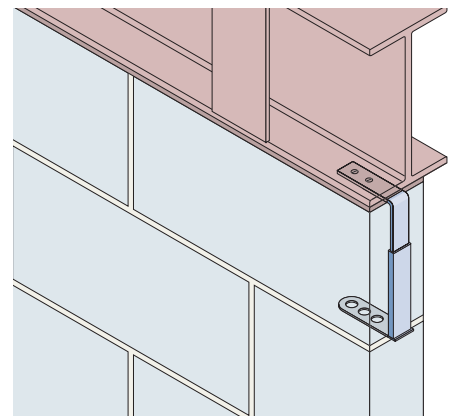
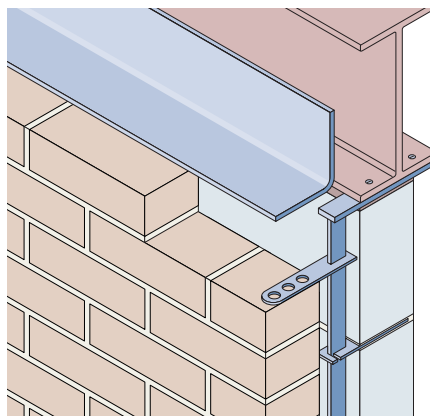
Halfen self-drill and tap screws may also be used for fixing sliding brick anchors, Code SBA or CHR. See product details on pages 28 and 29. For screw details, please consult Halfen Limited.

Specification: Structure > 4 < 12 mm

BZP screw code HDT 12 x 40

Stainless screw code HSD 12 x 40

2 No. per sliding brick anchor



# Hammer-set wire ties

## HEA and LSA 4

HEA and LSA 4 are hammer-set wire cavity wall ties, used when the inner skin has been built before the outer skin. They are easier to use than frame cramps and do not require separate fixing and plate washers. The bond in the outer skin is formed when the wire is bent at right angles on site. This gives loads to DD140 Type 2. Ties are made in stainless steel only. For full details please consult Halfen Limited.

### HEA

HEA ties have a forged collar and loose expansion sleeve and are suitable for concrete backgrounds only, e.g. beams or core walls.

### LSA 4

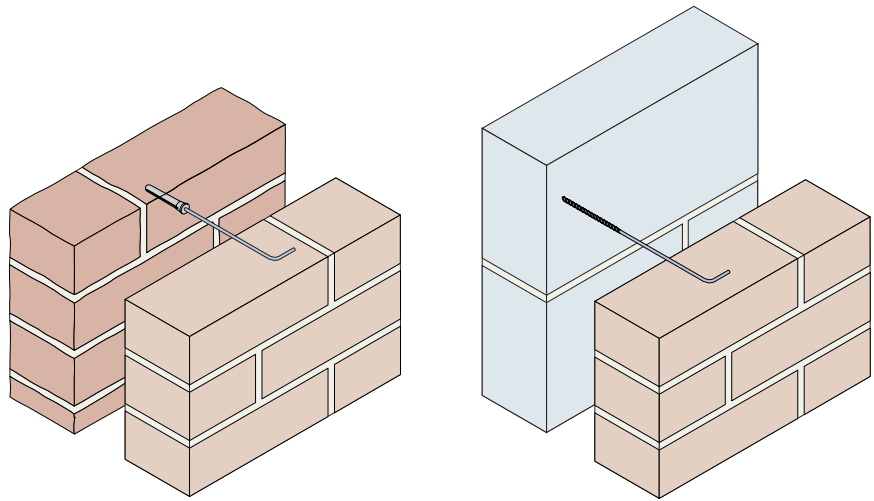
LSA 4 ties are threaded for a hammer-set plug, and are suitable for backgrounds of dense brick or dense blockwork

### HPV-L

HPV-L ties are similar to LSA 4, but are screwed in using a driving tool and power drill. The ties are manufactured in stainless steel.

### Applications

HPV-L ties are designed for use in light block inner skins, e.g. aerated concrete such as Thermalite, Celcon, Durox etc.



Wire tie fixing into existing dense brickwork

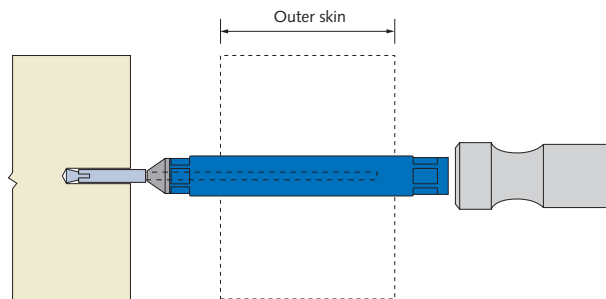
Wire tie fixing into existing dense blockwork



HEA tie with collar and sleeve



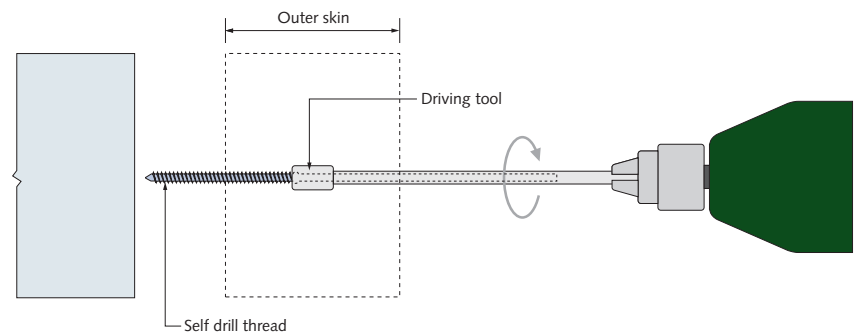
LSA 4 tie with thread for plastic plug



HEA and LSA 4: hammer-set using a tubular steel tool



HPV-L tie with thread



HPV-L tie screw-set using HPV-Z1 driving tool