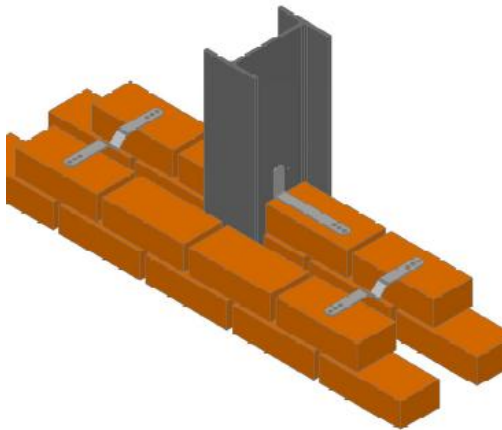


Fixing Frame Cramps to structural steel sections

Frame cramps and wall ties.

A frame cramp is used to transfer the loads from a masonry panel to an adjacent structural unit. Depending on the location of the cramp the loads may be predominantly tensile or shear. Wall ties are used to tie the outer leaf of a cavity wall to the inner leaf and to transfer the wind loads between the two parts of the structure. A wall tie will typically be loaded predominantly in tension.



In this example the wall ties are transferring the wind load from the outer brick leaf to the inner brick leaf with the ties acting in tension and the frame cramp is transferring the load from the inner leaf to the structural steel column with the load acting in shear on the fixing.

The frame tie and its fixing element must be designed to transfer the load from the masonry panel to the structural frame and the designer of the brickwork must ensure that sufficient fixings are provided to enable this to occur considering both the properties of the frame cramp and the properties of the fixing. When a Frame cramp is acting to resist a tensile load then the fixing and the cramp should be designed to resist at least the load and displacement requirements for a wall tie.

Technical requirements for wall ties

Wall Tie Spacing and Positioning

The requirements for spacing and positioning of wall ties are laid down in BS5628: "The structural use of masonry": Part 1: 1992 please refer to this document and to the current editions of the Building regulations for specific requirements. For a general case the ties should be installed at not less than 2.5 per square metre. This equates to 900mm horizontal spacing and 450mm vertical centres. The ties should be evenly distributed over the wall and be staggered. Additional ties are required at 300mm intervals beside openings and expansion joints, these ties should be located 22mm from the vertical edge.

DD140 gives the performance requirements and for a Type 2 tie they are:-

Tensile characteristic failure load	1800(N)
Tensile force at a serviceability deflection of 0.5mm	500(N)
Compressive characteristic failure load	1300(N)
Compressive force at a serviceability deflection of 0.5mm	400(N)

From DD140 it can be seen that class 2 wall ties are able to allow some relative movement between the two leaves of a cavity wall, and that the deflection allowable in the tensile direction is limited. This movement is controlled by the properties of the frame cramp and the location of the fixing in it rather than the fixing element itself.

Fixing frame cramps to structural steel

Frame cramps can be made from galvanized steel or stainless steel and can be fixed to structural steelwork using DX powder actuated fixings, self-drilling self-tapping screws, or self-tapping screws may be used with predrilled holes in the steel. Frame cramps may also be fixed to concrete by means of small anchors but these won't be discussed any further here.

Where frame cramps are fitted outside the vapour barrier of the structure so must be assumed to be installed into damp conditions and where the frame cramps are made from stainless steel, the combination of these with a structural steel frame requires consideration when selecting the fixing to use.

Using Stainless steel frame cramps and fixings

The preferred arrangement is to use a stainless steel tie and a stainless steel nail (ideally the X-QT frame cramp with pre-mounted nail) however the individual site conditions have to be considered and particularly the thickness and strength of the steel that is being fixed into. Full application limits are given in our technical literature



Quick Tie frame cramp with pre-assembled XCR16-4.5 P8THP nail.

This is the easiest method to use on site as it eliminates any error due to poor placing of the nail against the frame cramp and the top hat THP washer gives the best connection between the fixing element and the frame cramp. Excellent guidance is given which gives the best result for all base steels. Corrosion of the structural member will be minimal due to its large mass compared with the mass of the cramp and the fastener. The X-QT is unsuitable for use in applications where it will be subject to a tensile load.

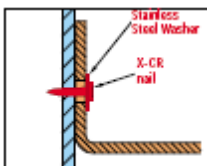
X-CR 14 or 16 nail; or a stainless steel screw fixed through the hole in the frame cramp.

This allows the use of other thicknesses of frame cramps with a greater stiffness to be used.

Check nail head or washer diameter is compatible with the hole diameter in cramp.

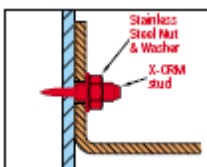
With DX fixings this method minimises the driving resistance, but reduces the guidance to the nail, which may result in placing failure due to bending of the nail and depending on the tool being used, it can be difficult to align the nail with the hole.

When using self-drilling screws to fasten frame cramps care must be taken to ensure that the thickness of the steel is within the allowable drilling range of the screw and when fixing into the face of a steel column the fixing is not located over the web of the column.



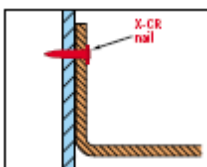
X-CR M6 11 or X-CR M8 11. Threaded Stud.

Because the frame cramp is not in position when the stud is placed, this method is suitable for slightly higher strength steels than the X-CR nails. This method is also advantageous for slotted Frame Cramps and particularly where the frame cramp is also doing duty as a wall tie, where it is necessary to keep the fixing as near to the horizontal portion of the frame cramp as possible to minimize the deflection under load of the cramp.



X-CR 14 or 16 nail fixed through the body of the frame cramp.

Depending on the shape and thickness of the frame cramp it may be possible to fix directly through the body when the fixing hole slots are not suitable to fix through.



Using Non-stainless fasteners

With powder actuated fixings, if the base steel is too strong resulting in a high proportion of failed fasteners then the use of a "Standard" X-U nail may be considered. However when these are used two corrosion mechanisms must be considered. These are also important when zinc plated screws are used to fix frame cramps.

Surface corrosion



Occurs when a fastener is exposed to both moisture and air.

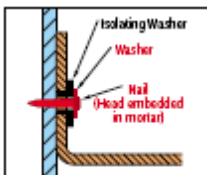
Can be reduced by protecting the fastener from moisture.

Bimetallic corrosion



Occurs when a carbon steel fastener is used in contact with a stainless steel frame cramp and moisture can make contact with both the fastener and the cramp

Can be reduced by separating the two components with a special isolating washer (item number 00058806) and protecting the fastener from moisture.



Isolation between the fixing and the frame cramp

Where standard powder actuated fixings or where steel screws are used to fix stainless steel cramps the use of an isolating washer alleviates the problem of bimetallic corrosion, the head of the fixing can be covered by mortar or otherwise protected from moisture, to reduce the likelihood of surface corrosion of the fixing.

Rating matrix for using a insulating washer

		Frame cramps fixed to concrete		Frame cramps fixed to steel	
		stainless steel nail	carbon steel nail	stainless steel nail	carbon steel nail
Indoor Application*	steel frame cramp				
	stainless	not needed	✓	not needed	✓
	carbon	✓	not needed	✓	not needed
Outdoor Application	steel frame cramp				
	stainless	not needed	⊘	not needed	⊘
	carbon	⊘	⊘	⊘	⊘

* without condensation, humidity and corrosive gases

✓ Insulating washers must be used to prevent from contact corrosion

⊘ The using of carbon steel in outdoor application is classified as critical cause by the hydrogen embrittlement and will not be recommended by Hilti.

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With all these methods care must be taken to make sure that the correct embedment of the fixing is obtained into the structural steel and that the frame cramp is bearing on the steel. Please call our customer services department to arrange for installation training for the site operatives.

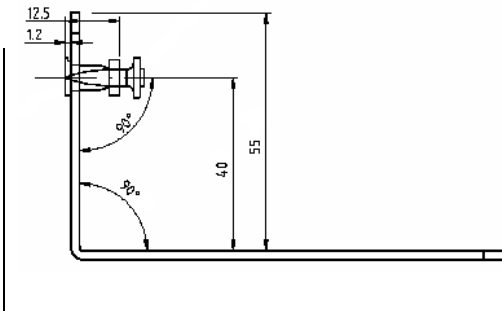
Fixing galvanised steel frame cramps

In principle fixing galvanized frame cramps is no different to fixing the stainless ones however instead of using the X-CR stainless steel nails and studs the X-U nails and X-EM threaded studs. And all the methods discussed under fitting stainless steel frame cramps (except for the X-QT) can be used with the standard studs and nails. There should be no need to use stainless steel nails with galvanized ties so bimetallic corrosion should not be an issue and isolating washers will not be required.

X-QT Frame cramp

A range of stainless steel frame cramps with pre-assembled high strength stainless steel nails for restraining masonry to structural steel

Product data



Fastening tool **DX 460-F8**



Cartridges:
6,8/11M,
Red or Black

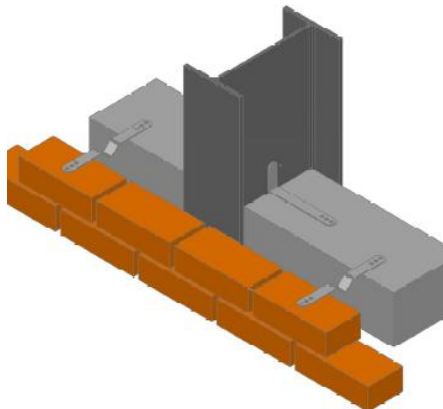
Piston: X-460-P8
Fastener Guide: X-460-F8

Specification

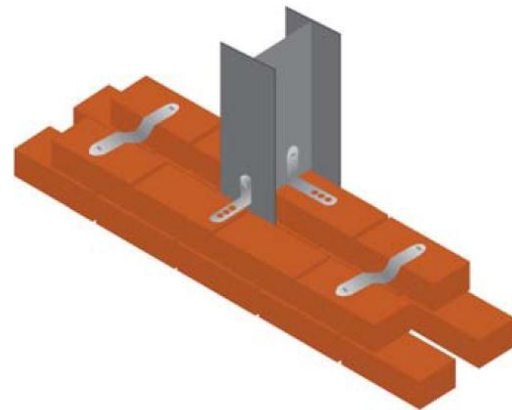
- Cramp: stainless steel 1.4301 (X5CrNi1810) according to EN 10088-2
corrosion resistance: A2 or AISI 304
Thickness: 2.0 mm for X-QT 100/125/150/175/200
2.3 mm for X-QT 225/250
- Fastener: stainless steel CR 500, zinc plated
corrosion resistance: A4 or AISI 316
diameter: 4.5 mm, shank length 16 mm)
- Washers: plastic (polyethylene)

Application and intended use

Shear connection of the inner leaf of a cavity wall to the structural steel column.
Condition: The density of wall ties connecting the inner and the outer leaf according to BS 5628-1 need to be observed (e.g. 2.5 ties/m² where both leaves are thicker than 90 mm).



Standard shear use of X-QT frame Cramp



Acceptable use of X-QT Frame Cramp in tension

Standard Quicktie

Designation	Item No	Box Contents	Tool
X-QT100 CR 16-4.5 P8THP	361734	100	DX 460-F8
X-QT125 CR 16-4.5 P8THP	361735	100	DX 460-F8
X-QT150 CR 16-4.5 P8THP	361736	100	DX 460-F8
X-QT175 CR 16-4.5 P8THP	361737	100	DX 460-F8
X-QT200 CR 16-4.5 P8THP	361738	100	DX 460-F8
X-QT225 CR 16-4.5 P8THP	361739	100	DX 460-F8
X-QT250 CR 16-4.5 P8THP	361740	100	DX 460-F8

Recommended loads

Connection between X-QT and structural steel

X-QT	V_{rec} [kN]	N_{rec} [kN]
X-QT 100/125/150/175/200	2.0	0.06
X-QT 225/250	2.0	0.09

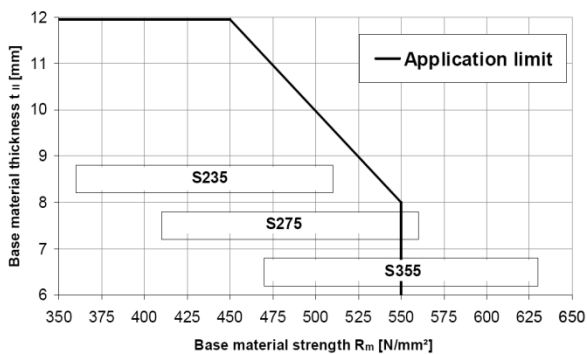
V_{rec} [kN] ... recommended shear load
 N_{rec} [kN] ... recommended tension load
 Note on N_{rec} : N_{rec} is based on the serviceability criterion of an elastic deformation of 0.5 mm.

Design conditions:

- Redundancy (multiple fastening) must be provided.
- Valid for predominantly static loading (wind is considered as predominantly static).
- Anchorage of the cramp within the masonry needs to comply with recognized provisions.

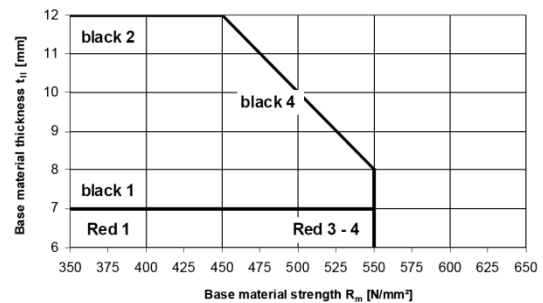
Application limit and cartridge recommendation

Application limit



Base material specification:
 Non-alloy structural steel acc. to EN 10025-2.
 Range of base material thickness t_{II} :
 $6.0 \text{ mm} \leq t_{II} \leq 12.0 \text{ mm}$

Cartridge recommendation

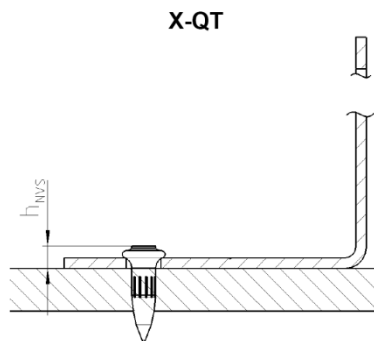


Cartridges: 6.8/11M black or red
 Red: $6.0 \text{ mm} \leq t_{II} \leq 7.0 \text{ mm}$
 Black: $t_{II} > 7.0 \text{ mm}$

The numbers in the chart refer to the recommended tool settings. In case the actual strength of the base material is unknown, start with the setting for low strength steel (Red 1 or black 1 and 2, respectively). If necessary, adjust tool energy setting in order to achieve consistent compliance with the required nail head standoff.

Fastening Quality Assurance

Fastening inspection



$h_{NVS} = 3.5 \text{ to } 5.5 \text{ mm}$



The photograph gives a visual impression of a correctly driven pin.

h_{NVS} ... Nail head standoff = Distance from top of the driven pin to the top surface of the base material

**HILTI TECHNICAL ADVISORY SERVICE
TELEPHONE 0161 886 1144****IMPORTANT NOTES**

1. The information and recommendations given herein are believed to be correct at the time of writing. The data has been obtained from tests done under laboratory, or other controlled, conditions and it is the users' responsibility to use the data given in the light of conditions on site and taking account of the intended use of the products concerned. Whilst Hilti (Gt. Britain) Limited can give general guidance and advice, the nature of Hilti products means that the ultimate responsibility for selecting the correct product for a particular application must lie with the customer.
2. All products must be used, handled and applied in accordance with current instructions for use published by Hilti (Gt. Britain) Limited.
3. All products are supplied, and advice given, subject to Hilti (Gt. Britain) Limited terms of business.
4. Hilti's policy is one of continuous development. We therefore reserve the right to alter specifications etc. without notice.
5. Construction materials and conditions vary on different sites. If it is suspected that the base material has insufficient strength to achieve a suitable fixing, contact the Hilti Technical Advisory Service.

