CAT-TIE

Introduction

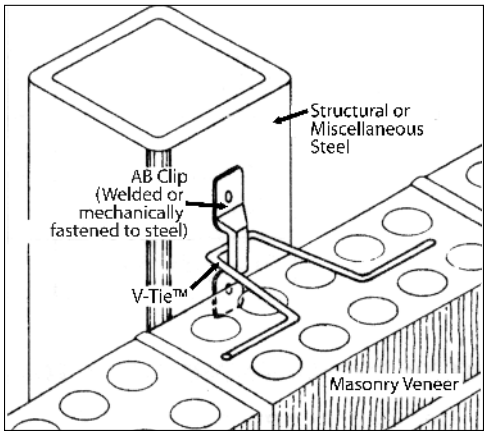

Figure 1 Cat-Tie System Application

The CAT-Tie (Column Adjustable Tie) System is a "surface mounted" masonry tie and anchor system that onsists of a slotted AB-Clip and a V-Tie™ (a V-shaped wire). The installed Cat-Tie System is illustrated in *Figure 1*. Individual components are shown in *Figures 2 and 3*, respectively. It is a heavy-duty, multi-component, adjustable tie system designed to resist high lateral loads. The Cat-Tie System can be welded or mechanically fastened directly to the surface of steel members to provide structural support for masonry.

Tensile lateral loads applied to the masonry are transferred through the V-Tie™ and resisted by the AB-Clip. Compressive lateral loads transferred through the V-Tie™ are resisted by the steel structural backing. The vertical slot formed between the AB-Clip and structural backing through which the wire V-Tie™ is inserted provides a positive connection without the possibility of V-Tie™ disengagement during construction and in-service (in compliance with requirements in CSA A370, *"Connectors for Masonry"*, and ACI 530/ASCE 5/TMS 402, *"Building Code Requirements for Masonry Structures"*). The slot permits up to 30 mm (1.2") of in-situ vertical adjustment, and also accommodates vertical differential movement between the masonry veneer and the structural backing.

Cat-Tie System Components and Specifications

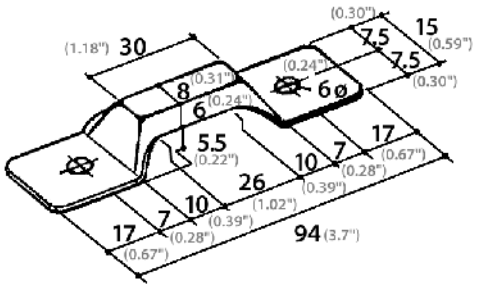

Figure 2 AB-Clip

AB-Clip: The AB-Clip *(Figure 2)* is manufactured from 16 gauge sheet steel [(1.367 mm (0.0538") minimum base steel thickness] and is available in both hot-dip galvanized finish and stainless steel. The weight of the hot-dip galvanized finish in not less than 460 g/m²/side (1.5 oz/ft²/side), and satisfies the requirements of CSA A370 (which references ASTM A123), ACI 530.1/ASCE 6/TMS 602 (which references ASTM A153, Class B), and the International Building Code (IBC) (which reference ASTM A153, Class B). The AB-Clip is offered in one standard size and configuration, as detailed in *Figure 2*.

V-Tie™: The V-Tie™ *(Figure 3)* is manufactured from 4.76 mm (0.19") diameter wire and is available in both hot-dip galvanized finish and stainless steel. The weight of the hot-dip galvanized finish is not less than 460 g/m² (1.5 oz/ft²), and satisfies the requirements of CSA A370 (which references ASTM A123), ACI 530.1/ASCE 6/TMS 602 (which references ASTM A153, Class B), and the International Building Code (IBC) (which reference ASTM A153, Class B).

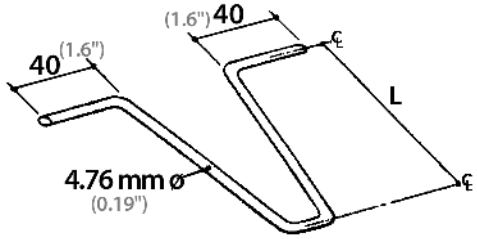

Figure 3 V-Tie™

The V-Tie™ is available in a variety of standard lengths to accommodate different thicknesses of masonry veneer and design widths of air space. The design length of V-Tie™ should be selected so its legs are suitably positioned within the masonry veneer (or other masonry member) being anchored (see "Cat-Tie System Performance and Placement"). Varying lengths of V-Tie™ can be appropriately selected by the mason on the jobsite to facilitate in-situ adjustment normal to the structural backing (where needed to accommodate construction tolerances). Standard lengths of V-Tie™ include 60 (2.4"), 80 (3.1"), 100 (3.9"), 120 (4.7"), 140 (5.5"), 160 (6.3"), 180 (7.1"), 200 (7.9"), 225 (8.9") and 250 mm (9.8") lengths. By selecting the appropriate length of wire V-Tie™, cavity widths of 15 mm (0.59") to 200 mm (8") can be accommodated. Specify the V-Tie™ size as the distance between the exterior face of the structural backing to the required centreline of engagement of its legs within the masonry member or veneer.

Performance and Placement

The Cat-Tie System can be used with masonry walls constructed of solid or hollow units. For solid masonry walls, the legs of the V-Tie™ must be placed at the centre-line of the wall in full mortar bed joints (within permissible construction tolerances). For hollow masonry walls, the legs of the V-Tie™ must be placed at the centreline of the exterior face shell of the masonry unit. For increased pullout capacity, the legs of the V-Tie™ can be mortared or grouted into the cores of the hollow masonry units.

The unique configuration of the V-Tie™ *(see Figure 3)* intended for use with FERO Engineered Masonry Connectors and the Cat-Tie offers greater pullout and push through capacity from the masonry mortar bed than do other proprietary and conventional ties. The area of mortar effective in resisting tie pullout for the V-Tie™ and for alternative ties embedded in a masonry veneer is illustrated in *Figure 4.* A comparison of the pullout capacities of these various tie types is presented in *Table 1*.

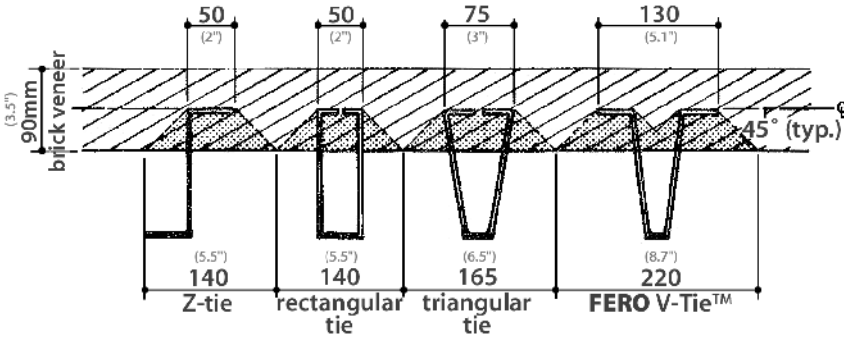

Figure 4 Effective Mortar Joint Area Pullout Resistance

Table 1 Comparison of Tie Pullout Capacity in 90 mm (3.5") Brick Application

Tie Type	Effective Mortar Area mm^2 (in^2)	% of V-Tie™ Pullout Capacity
FERO V-Tie™	7250 (11.24")	100
Z-Tie	4275 (6.63")	59
Rectangular Tie	4275 (6.63")	59
Triangular Tie	5400 (8.37")	74

Structural Action

The Cat-Tie System is designed to transfer the lateral load from the exterior masonry axially and normal to the structural backing. By way of the vertical slot, the connection between the V-Tie™ and the slotted AB-Clip does not resist differential movement in the vertical direction and therefore does not offer composite action between the structural backing and the masonry.

The fasteners connecting the AB-Clip to the structural backing resist loads in direct tension. Two (2) fasteners must be used and the fasteners must have sufficient diameter, length, and embedment depth to safely resist the lateral load imposed by the V-Tie™. Alternatively, the Cat-Tie may be welded to the structural backing. Where an intervening secondary component such as sheathing exists between the structural backing and the Cat-Tie, consider the use of the Fero Pac-Tie System.

Note: Refer to the FERO-FASTENERS brochure for complete specifications.

Design Data *(Canada)*

The Cat-Tie System includes both the AB-Clip and V-Tie™. Design data for the Cat-Tie System are reported separately for Canada and the United States in the following tables because design methods and requirements for masonry ties and their uses differ between their respective codes and standards.

Design Parameter	Design Data [(i),(ii)]	
1. Mechanical Free Play [(iii)] (with FERO V-Tie™)	0.74 mm (max) [0.029″]	
2. Serviceability at 0.45 kN [100 lbs.] [(iii)] Displacement Displacement + Mechanical Free Play	 0.45 mm [0.018″] 1.19 mm (max) [0.047″]	
3. Factored Resistance (φP_{ult}) [(iv),(v),(vi)]	1.34 kN [300 lbs.]	
4. Maximum Recommended Spacing [(vii)]	Masonry Tie	Masonry Anchor
	800 mm [32″] Horiz. 600 mm [24″] Vert.	See requirements in Clause 7 of CSA A370

Notes:

(i) These design data are based on testing in accordance with CSA A370-14, with no surcharge, and with test samples having the following configuration: 102 mm [4″] cavity; standard AB-Clip and Fero V-Tie™; two (2) fasteners connecting the Cat-Tie System to the structural backing; and V-Tie™ positioned at the AB-Clip centreline. Smaller cavity widths will increase the tabled factored resistance of the tie and reduce tie deflections.

(ii) These design data reflect both the windward (compression) and leeward (tension) capacities of the Cat-Tie System, with the governing values listed.

(iii) The Cat-Tie System satisfies the limiting requirements for serviceability (tie displacement and free play) in CSA A370-14. Tabled mechanical free play is for stainless steel components. The mechanical free play for hot-dip galvanized components is less.

(iv) The ultimate strength of the Cat-Tie System, P_{ult}, is determined in accordance with CSA A370-14, and is calculated by multiplying the average tie strength established by testing by (1 – 1.64 cov). The factored resistance of the tie system (φP_{ult}) is calculated using Limit States Design, with $\varphi = 0.9$, and following the procedures of CSA A370-14.

(v) The stated tie factored resistance is based on the capacity of Fero tie components and does not consider fastener resistance. A compatible fastener, or weld, having an adequate factored resistance must be selected (by design in accordance with CSA A370-14).

(vi) The factored resistance of the mortar pullout or pushout for the V-Tie™ embedded at the centreline of 90 mm (3.5″) brick veneer utilizing Type S or N mortar exceeds or equals the tabled factored resistance, φP_{ult}. That is, failure by pullout/pushout of the mortar joint does not govern. Where the Cat-Tie is embedded along the face shell of a hollow masonry unit, the embedment depth is substantially less than 90/2 = 45 mm (1.75″), and the pullout/pushout load is reduced. In such cases, embedment failure may govern, and the factored resistance of the tie system (φP_{ult}) is calculated using Limit States Design with $\varphi = 0.6$. Where the legs of the V-Tie™ are engaged into grouted cells of the hollow masonry unit, the pullout/pushout load is increased.

(vii) Maximum recommended tie spacings are the maximum spacings permitted by CSA S304.1-14, *Design of Masonry Structures*. Maximum anchor spacing is the most restrictive of the calculated design spacing and the limiting maximum anchor spacing stated in Clause 7. For a particular design, the actual tie or anchor spacing is calculated such that the factored resistance of the tie/anchor, φP_{ult}, equals or exceeds the effect of factored loads. See also S304.1-14 for the design of masonry veneer systems.

Design Data *(United States)*

Design Parameter	Design Data [(i),(ii)]	
1. Mechanical Free Play [(iii)]	0.74 mm (max) [0.029″]	
2. Serviceability at 0.45 kN [100 lbs.] [(iii)] Displacement Displacement + Mechanical Free Play	 0.45 mm [0.018″] 1.19 mm (max) [0.047″]	
3. Nominal Strength [(iv),(v),(vi),(viii),(ix)]	400 lb [1.78 kN]	
4. Recommended Design Load [(iv),(v),(vi),(viii),(ix)]	178 lb [0.79 kN]	
5. Maximum Recommended Spacing [(vii)]	Masonry Tie	Masonry Anchor
	32″ [813 mm] Horiz. 18″ [457 mm] Vert.	See requirements in Clause 5.8 of ACI 530/ASCE5/TMS402

Notes:

(i) These design data are based on connector testing in accordance with CSA A370-14, *Connectors for Masonry*, with no surcharge and with test samples having the following configuration: 102 mm [4″] cavity; standard AB-Clip and Fero V-Tie™; two (2) fasteners connecting the Cat-Tie System to the structural backing; and V-Tie™ positioned at the AB-Clip centerline. The test method for ties in CSA A370-14 is comparable to that of ASTM E754, *Test Method for Pullout Resistance of Ties and Anchors Embedded in Masonry Mortar Joints*, and provides similar and more conservative results. Smaller cavity widths will increase the nominal strength of the tie and reduce tie deflection. Prescriptive requirements for anchored masonry veneer under ACI 530/ASCE 5/TMS 402 limit the cavity to a maximum width of 4-1/2″ (114 mm) unless the veneer is alternatively designed using a rational, engineered design method (termed "Alternative Design of Anchored Masonry Veneer").

(ii) These design data reflect both the windward (compression) and leeward (tension) capacities of the Cat-Tie System, with the governing values listed.

(iii) The Cat-Tie System with V-Tie™ satisfies the 1/16″ (1.6 mm) maximum permissible clearance between connecting parts required by ACI 530/ASCE 5/TMS 402. Tabled mechanical free play is for stainless steel components. The mechanical free play for hot-dip galvanized components is less.

(iv) The nominal strength of the Cat-Tie System is determined by test and is reported as the average ultimate strength of the tie samples. In accordance with ACI 530/ASCE 5/TMS 402, using Strength Design, a suitable strength-reduction factor must be applied to the nominal strength to determine the tie design strength. Similarly, under Allowable Stress Design, an appropriate safety factor must be applied to determine an allowable load value. The tabled "Recommended Design Load" reflects a safety factor of 2.25 (that is, 75% of 3.0). [See also Note (vi) when assigning a strength-reduction factor to the nominal strength].

(v) The stated nominal strength and recommended design load do not consider fastener capacity or weld capacity. A compatible fastener or weld having an adequate strength must be selected (by design in accordance with ACI 530/ASCE 5/TMS 402).

(vi) The nominal strength (and corresponding recommended design load) of the mortar pullout or pushout for the V-Tie™ embedded at the centerline of 3.5″ (90 mm) brick veneer utilizing Type M, S or N mortar exceeds or equals the tabled nominal strength (and recommended design load). That is, failure by pullout/pushout of the mortar joint does not govern. Where the Cat-Tie is embedded along the face shell of a hollow masonry unit, the embedment depth is substantially less than 3.5″/2 = 1.75″ (45 mm), and the pullout/pushout load is reduced. Where the legs of the V-Tie™ are engaged into mortared or grouted cells of the hollow masonry unit, the pullout/pushout load is increased.

(vii) Maximum recommended tie spacings are the maximum spacings permitted by ACI 530/ASCE 5/TMS 402 using prescriptive requirements for anchored masonry veneer. The prescriptive requirements in ACI 530/ASCE 5/TMS 402 further limit a tie tributary area to not more than 2.67 ft.2 (0.25 m^2) wall area [with reduced areas for high Seismic Design Categories and in areas of high winds] unless the veneer is alternatively designed using a rational, engineered method (termed "Alternative Design of Anchored Masonry Veneer"). Where an Alternative Design is used, the required tie spacing may be calculated such that the design strength of the tie equals or exceeds the required strength. See ACI 530/ASCE 5/TMS 402 for the design of masonry veneer systems.

(viii) The V-Tie™ satisfies ACI 530/ASCE 5/TMS 402 requirements for minimum wire size of W1.7 (MW11) and for ends bent to form a minimum 2 in (50.8 mm) extension.

(ix) ACI 530/ASCE 5/TMS 402 requires joint reinforcement in masonry veneer in high Seismic Design Categories to be mechanically attached to the masonry tie.

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