Retrofit Anchoring of Masonry: Applications of Horizontal Joint Reinforcing

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Contents

- Introduction
- Veneer Instabilities & Causes
- Facade Repair Options
- Horizontal Joint Reinforcing
  - To understand the application and installation methods of horizontal helical joint reinforcement.
    - Crack Stitching
    - Masonry Beaming

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A History of Masonry Construction

Ancient civilization: 10000 BCE

Construction with stones and sun-dried mud bricks

Still fairly ancient: 4000 BCE

First known use of lime mortar

A bit less ancient: 3500 BCE

First kiln-dried bricks created

Roman Empire: 80 CE

Colosseum completed construction

Ancient Egypt: 2500 BCE

First uses of a mineral gypsum mortar

Middle Ages: 476 to 1400 CE

Castles and Cathedrals built of stone blocks and limestone plaster

Industrial Revolution: 1800 CE

Standardization of brick and improved infrastructure

1903 CE

First identifiable brick veneer construction

1930 CE

Zinc/galvanizing became accepted and introduced into the UBC.

Today

Masonry walls are becoming thinner and taller than ever

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Photos taken from Eyewitness News ABC7NY, March 1, 2023 https://youtu.be/Uf15mjdIPbc

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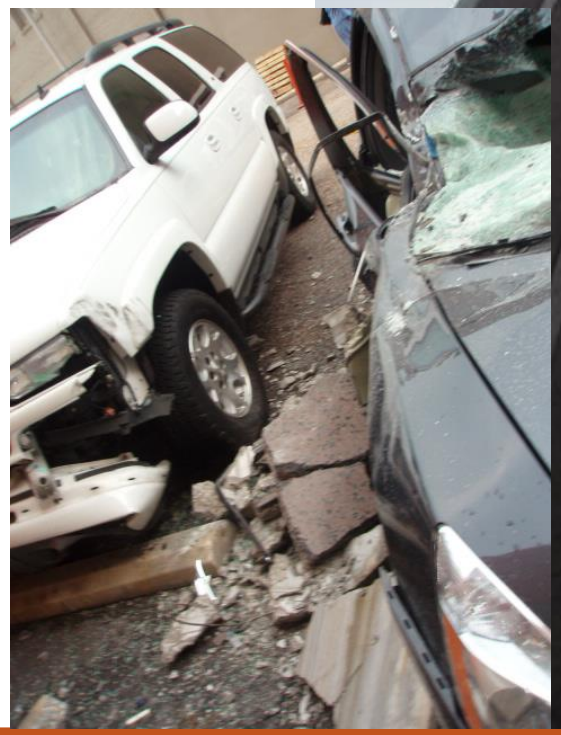
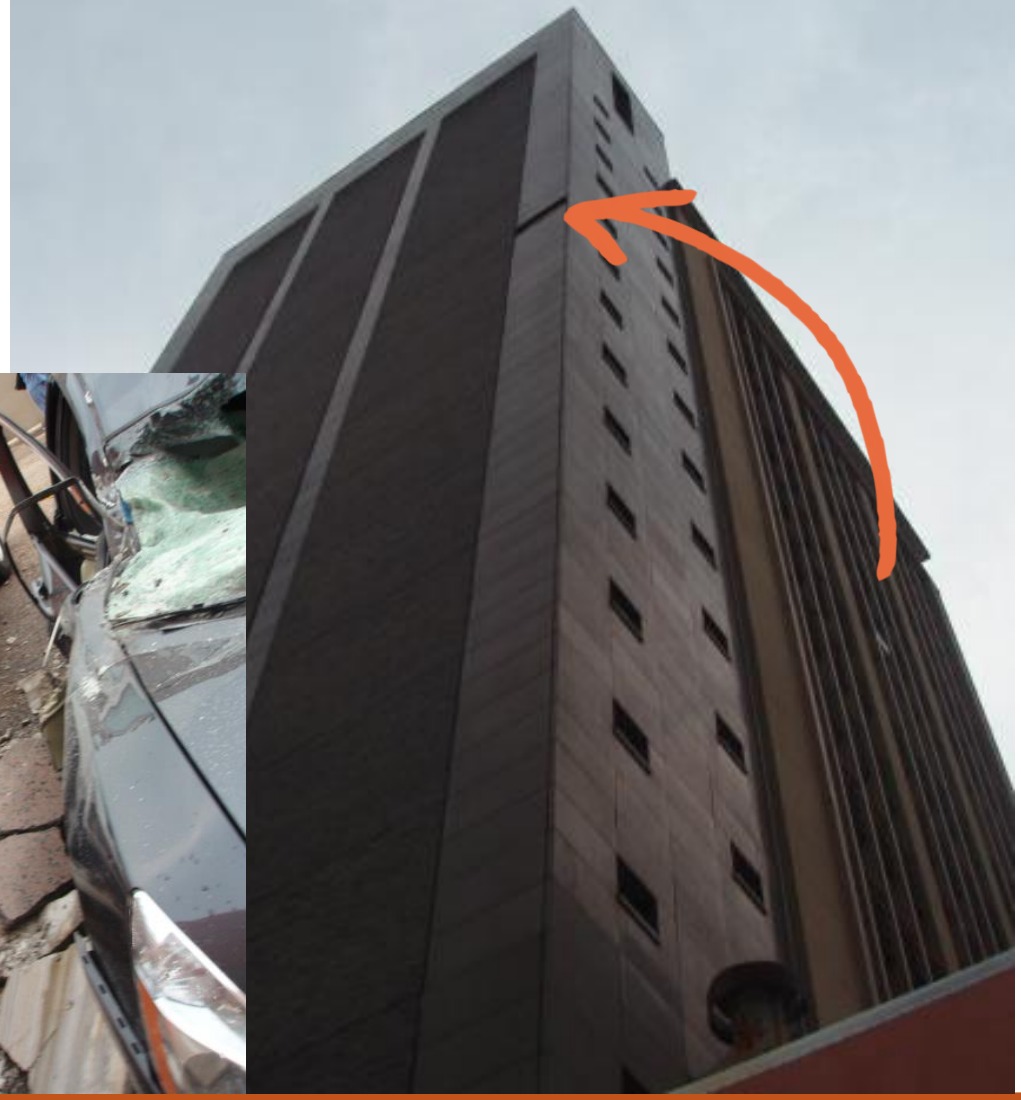
Veneer instabilities can be observed by excessive wall movement, bulges, cracks, excessive moisture intrusion, or ultimately a collapse.

The cause of each may vary, but the underlying issue needs to be recognized to repair the wall appropriately.





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Wall Movement

- Differential thermal/moisture expansion & contraction
- Cracks typically form along the mortar joints, but cracking along the face of the brick indicates a more significant wall movement or load present.

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Excessive Moisture

Stains related to excessive moisture can indicate locations of potential anchor failure.

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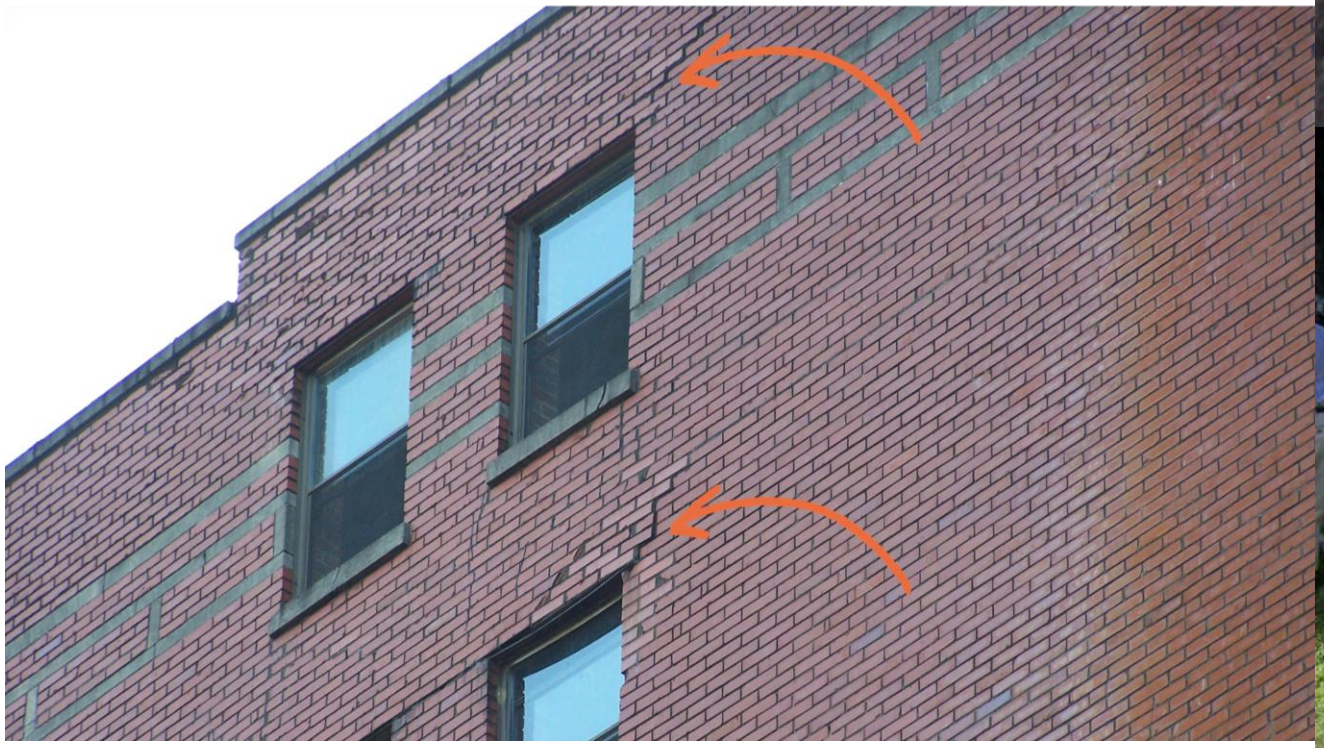
Corrosion



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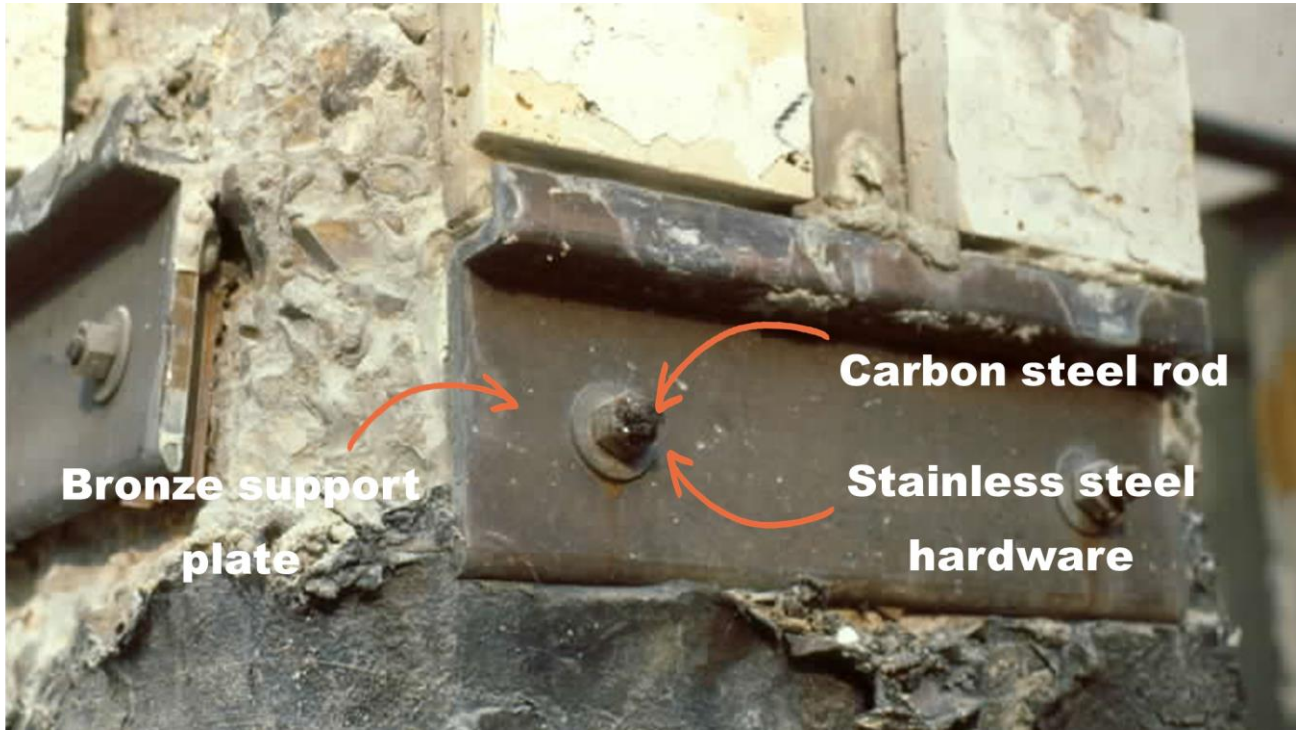
Corrosion



NOBLE/CATHODE (protected)	
Metallurgical Category	**Index (V)**
Gold	0.00
Copper	0.35
Brass & Bronze	0.40
304 & 316 Stainless Steel	0.50
Lead	0.70
Aluminum	0.75
Iron	0.85
Zinc	1.25
Magnesium	1.75
ACTIVE/ANODE (higher potential for corrosion)	

Harsh environments: 0.15 V difference or less

Normal environments: 0.25 V difference or less

Controlled environments: 0.50 V difference or less

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Common causes of Veneer Instability

Design/Workmanship	• Tie Omission • Improper Spacing • Poor Quality Installation
Tie Corrosion	• Moisture infiltration • Galvanic (Dissimilar Material) Corrosion
Environmental	• Fire • Flood • Earthquake

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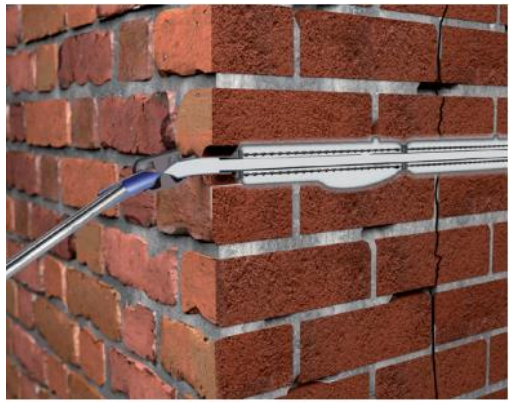
Retrofit anchoring solutions

Helical Anchors

(Keying based)

Mechanical Expansion Anchors

(Friction based)



Adhesive Anchors

Horizontal Joint Reinforcement

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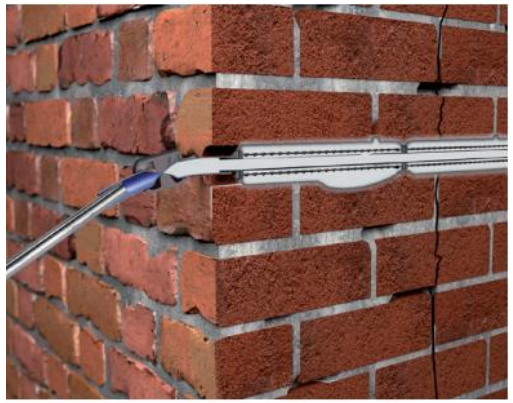
Retrofit anchoring solutions

Helical Anchors

(Keying based)

Mechanical Expansion Anchors

(Friction based)



Adhesive Anchors

Horizontal Joint Reinforcement

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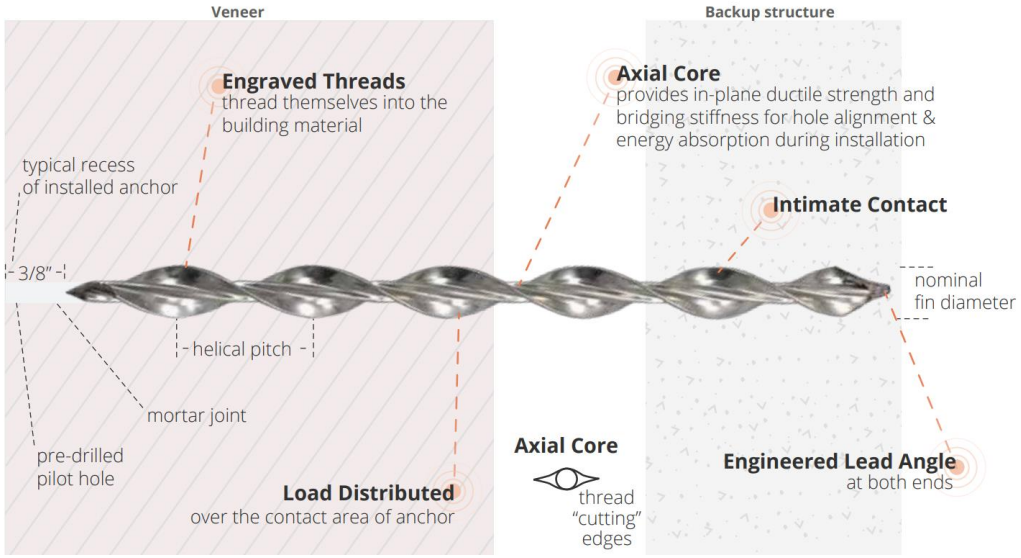
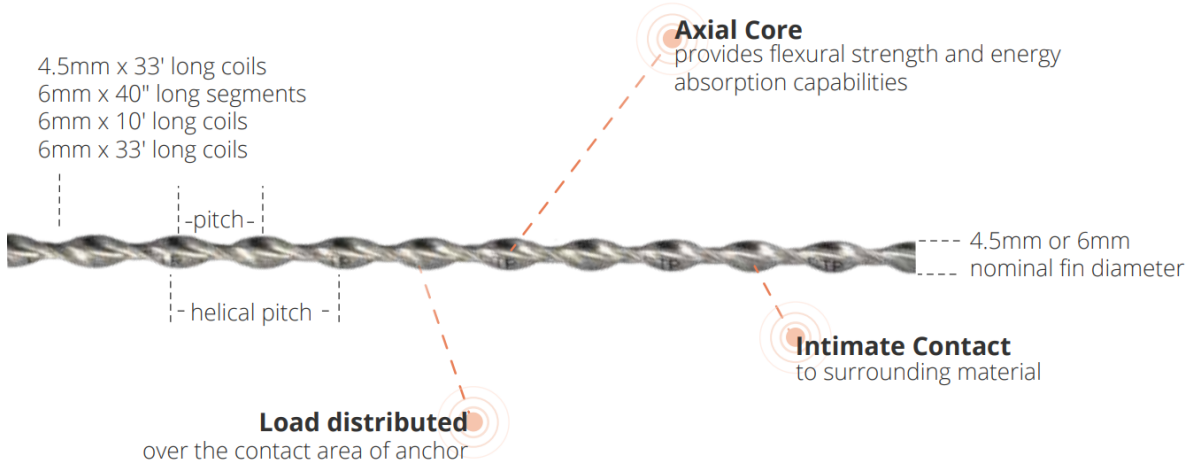
Supplemental lateral load reinforcing

8mm + 10mm ϕ Helical Pins



Supplemental Horizontal Joint Reinforcing

4.5mm + 6mm ϕ Bar & Thixotropic Grout



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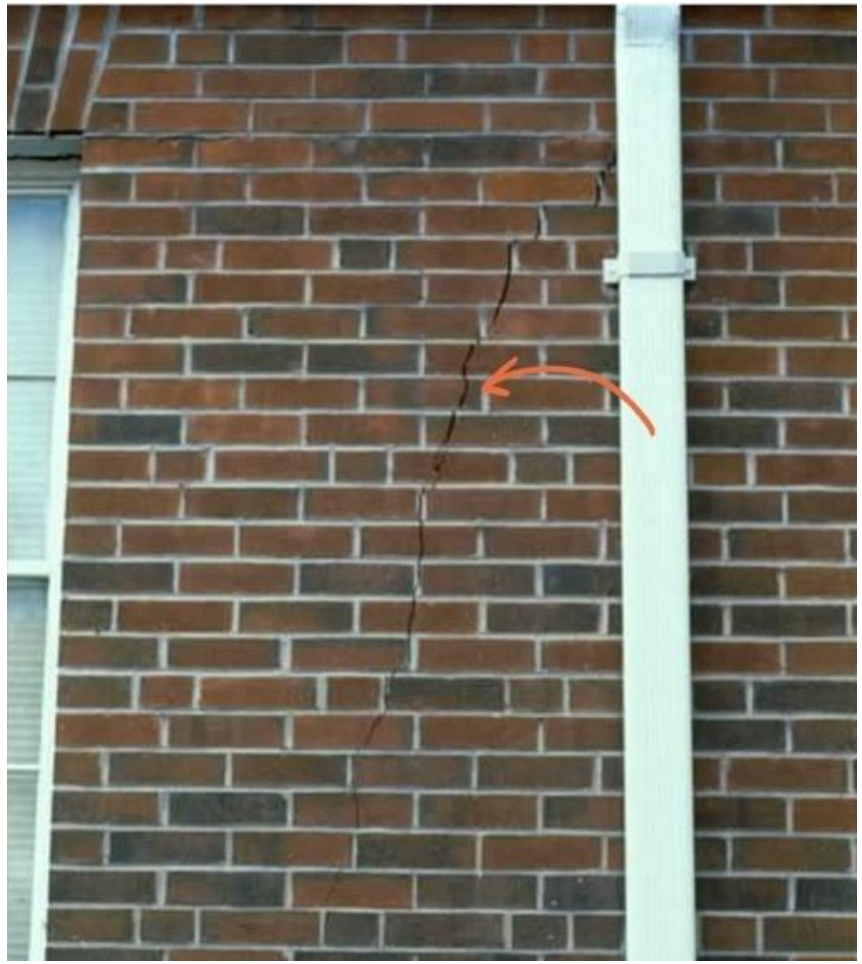

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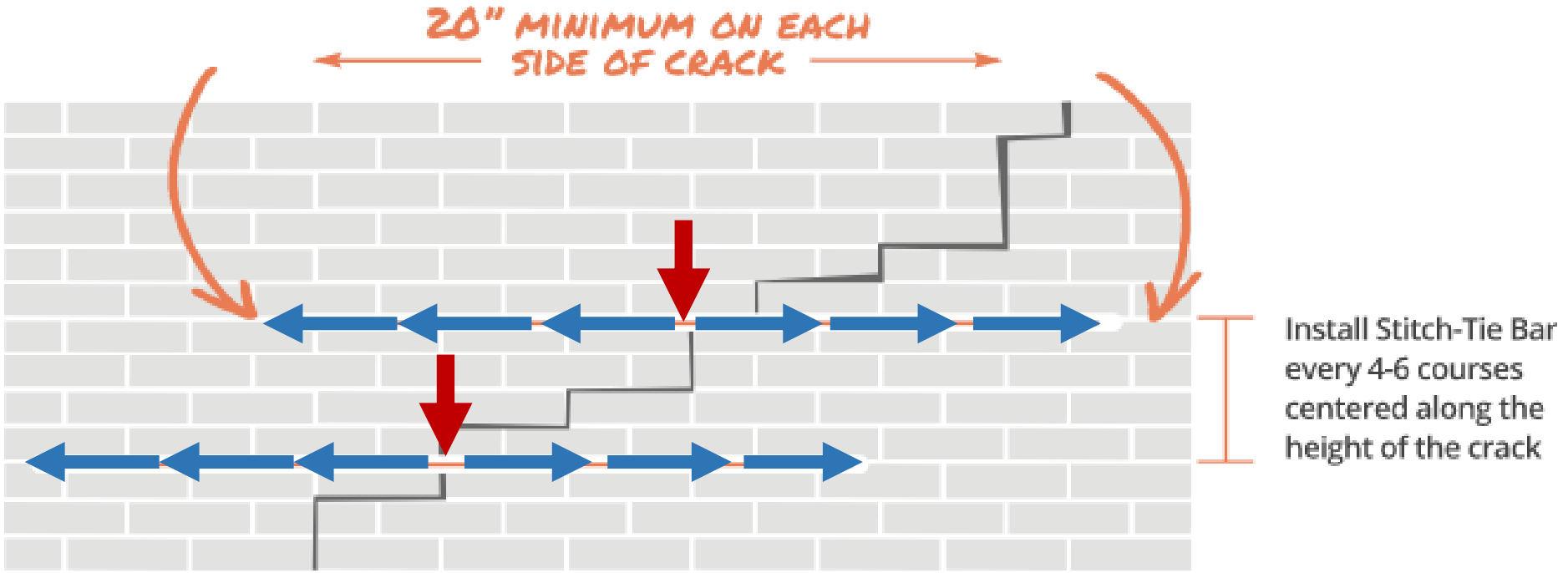
Crack Repair: Ties masonry back together and allows localized stress to be distributed over a larger area



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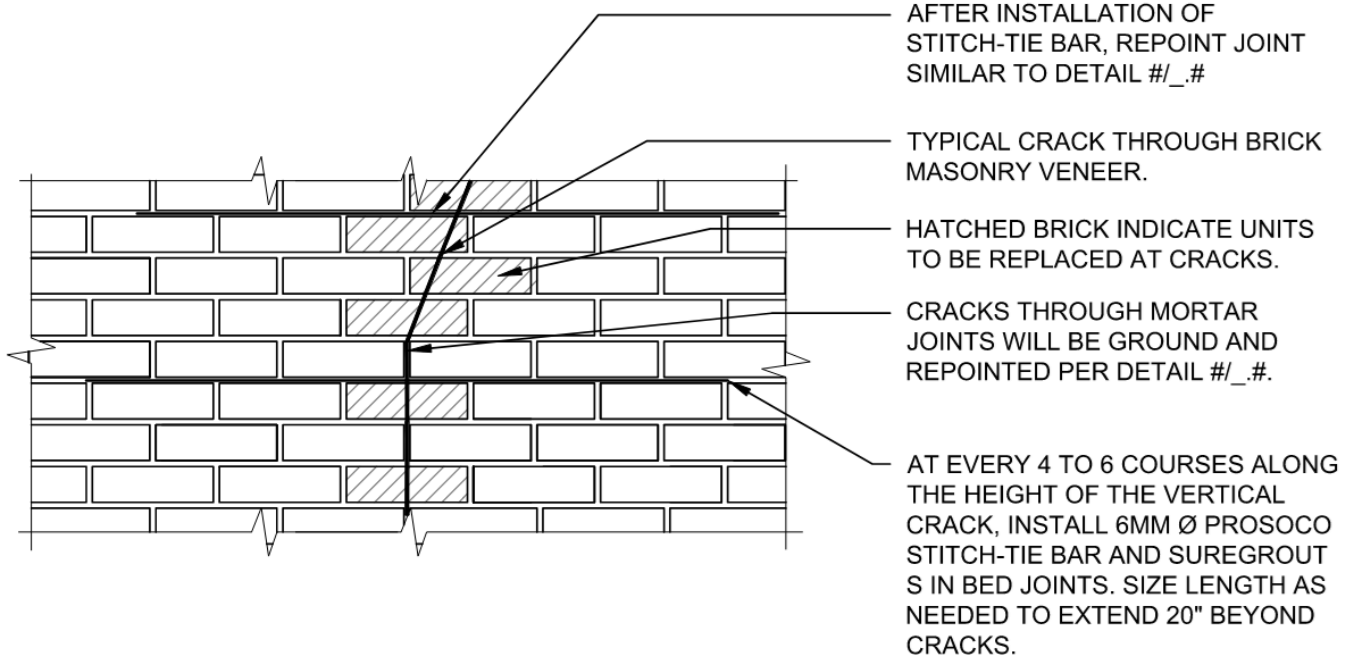
AFTER INSTALLATION OF STITCH-TIE BAR, REPOINT JOINT SIMILAR TO DETAIL #/_.#
TYPICAL CRACK THROUGH BRICK MASONRY VENEER.
HATCHED BRICK INDICATE UNITS TO BE REPLACED AT CRACKS.
CRACKS THROUGH MORTAR JOINTS WILL BE GROUND AND REPOINTED PER DETAIL #/_.#.
AT EVERY 4 TO 6 COURSES ALONG THE HEIGHT OF THE VERTICAL CRACK, INSTALL 6MM Ø PROSOCO STITCH-TIE BAR AND SUREGROUT S IN BED JOINTS. SIZE LENGTH AS NEEDED TO EXTEND 20" BEYOND CRACKS.

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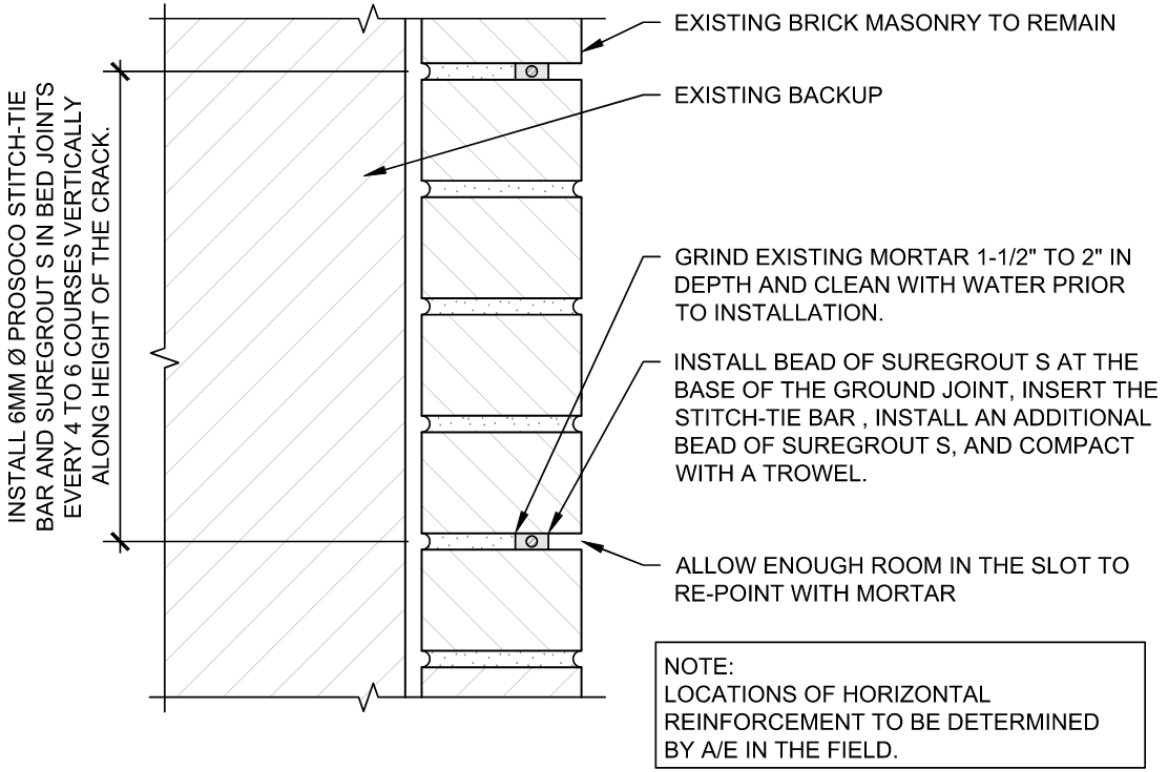
EXISTING BRICK MASONRY TO REMAIN
EXISTING BACKUP
INSTALL 6MM Ø PROSOCO STITCH-TIE BAR AND SUREGROUT S IN BED JOINTS EVERY 4 TO 6 COURSES VERTICALLY ALONG HEIGHT OF THE CRACK.
GRIND EXISTING MORTAR 1-1/2" TO 2" IN DEPTH AND CLEAN WITH WATER PRIOR TO INSTALLATION.
INSTALL BEAD OF SUREGROUT S AT THE BASE OF THE GROUND JOINT, INSERT THE STITCH-TIE BAR , INSTALL AN ADDITIONAL BEAD OF SUREGROUT S, AND COMPACT WITH A TROWEL.
ALLOW ENOUGH ROOM IN THE SLOT TO RE-POINT WITH MORTAR
NOTE:
LOCATIONS OF HORIZONTAL REINFORCEMENT TO BE DETERMINED BY A/E IN THE FIELD.

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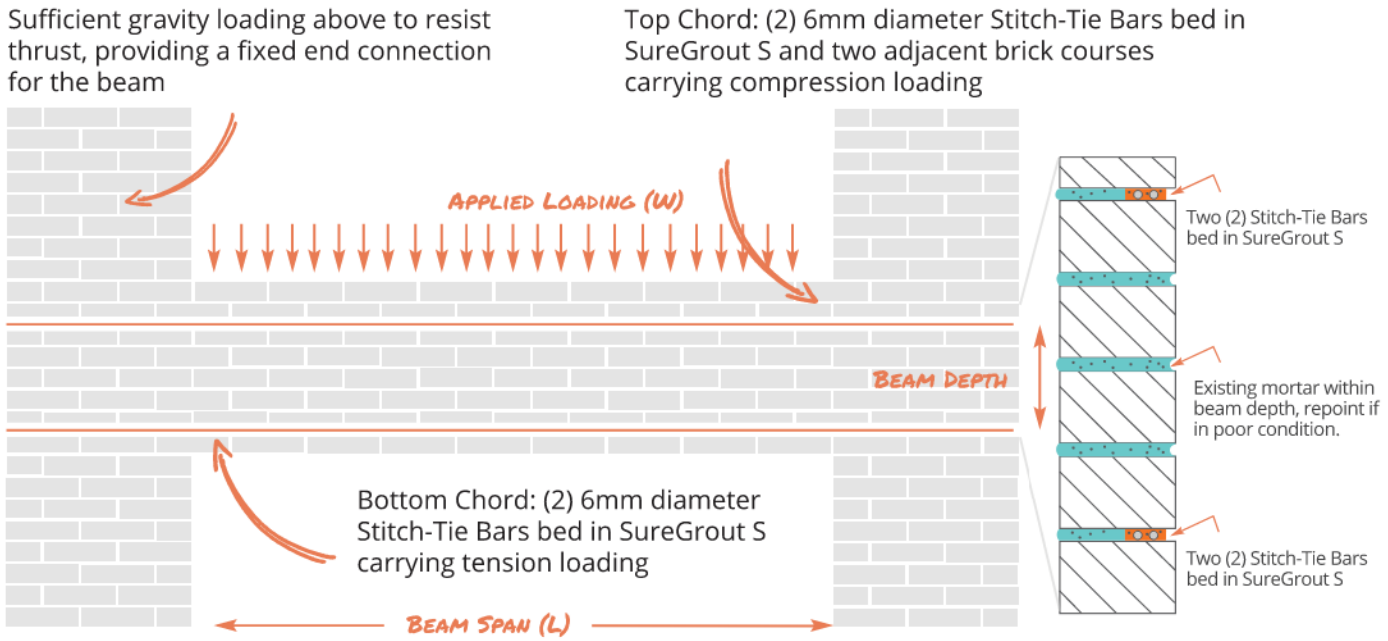
Alternative Application: Helical Masonry Beaming

A method to restore the structural integrity to a building where the masonry has failed or lost some of its load bearing capabilities.



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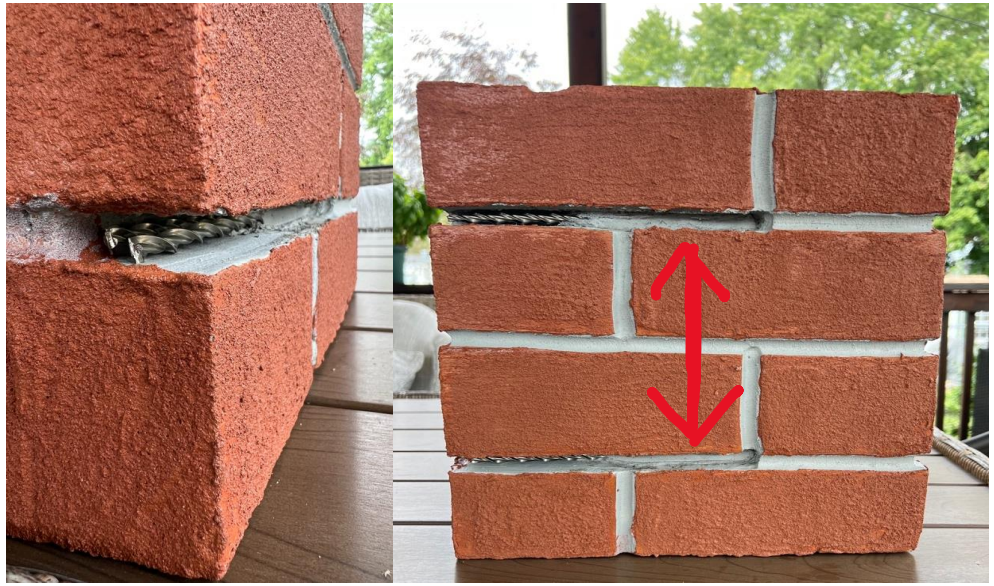
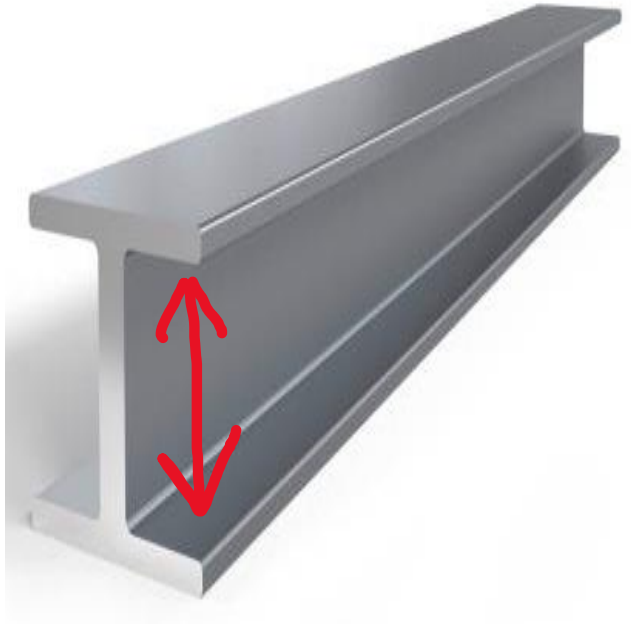
How does it work?

The reinforced bed joints form a top and bottom chord that act like the top and bottom flanges of a beam





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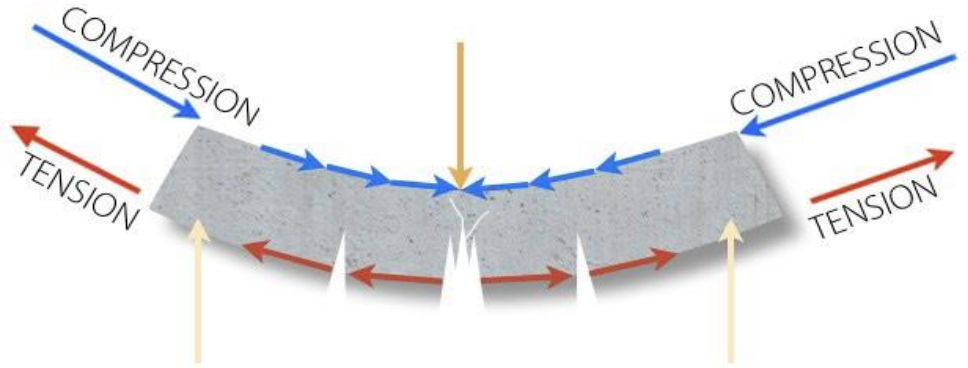
Or put another way…

One chord carries compression and the other resists tension loads.



This is the same principle that is used in reinforced concrete lintels above openings. Here, we use the existing masonry and 6mm diameter helical bars instead of concrete and rebar.

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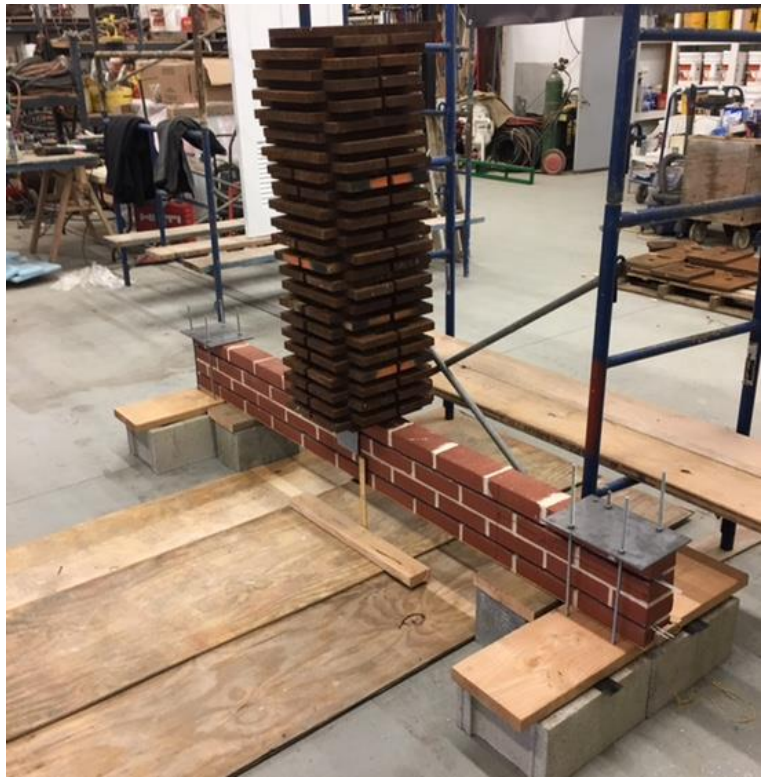
Is it strong?



Span	Beam Depth		
	0.3 m (**12"**)	0.6 m (**24"**)	0.9 m (**36"**)
1 m (**3.3'**)	26.9 KN/m (**1,840 lb/ft**)	26.9 KN/m (**1,840 lb/ft**)	26.9 KN/m (**1,840 lb/ft**)
1.5 m (**5'**)	17.7 KN/m (**1,210 lb/ft**)	17.7 KN/m (**1,210 lb/ft**)	17.7 KN/m (**1,210 lb/ft**)
2.0 m (**6.6'**)	13.0 KN/m (**890 lb/ft**)	13.0 KN/m (**890 lb/ft**)	13.0 KN/m (**890 lb/ft**)
2.5 m (**8.2'**)	8.9 KN/m (**610 lb/ft**)	9.6 KN/m (**660 lb/ft**)	9.6 KN/m (**660 lb/ft**)
3.0 m (**9.8'**)	-	8.7 KN/m (**600 lb/ft**)	8.7 KN/m (**600 lb/ft**)
3.5 m (**11.5'**)*	-	7.5 KN/m (**515 lb/ft**)	7.5 KN/m (**515 lb/ft**)

* **Note:** value for 3.50 m span is for 215 mm brickwork (double wythe) only. The values for 215 mm brickwork assume that the vertical joint through the thickness of the wall is filled and the wall acts compositely.

	Beam Depth		
	0.3 m **(12")**	0.6 m **(24")**	0.9 m **(36")**
Average Equivalent Bending Capacity (WL^2/12)	3,550 lb-ft	6,985 lb-ft	10,435 lb-ft
Average Equivalent Shear Capacity (WL/2)	2,920 lb	2,920 lb	2,920 lb

• Consult with an engineer or PROSOCO technical support to help with beam placement and load and calculations

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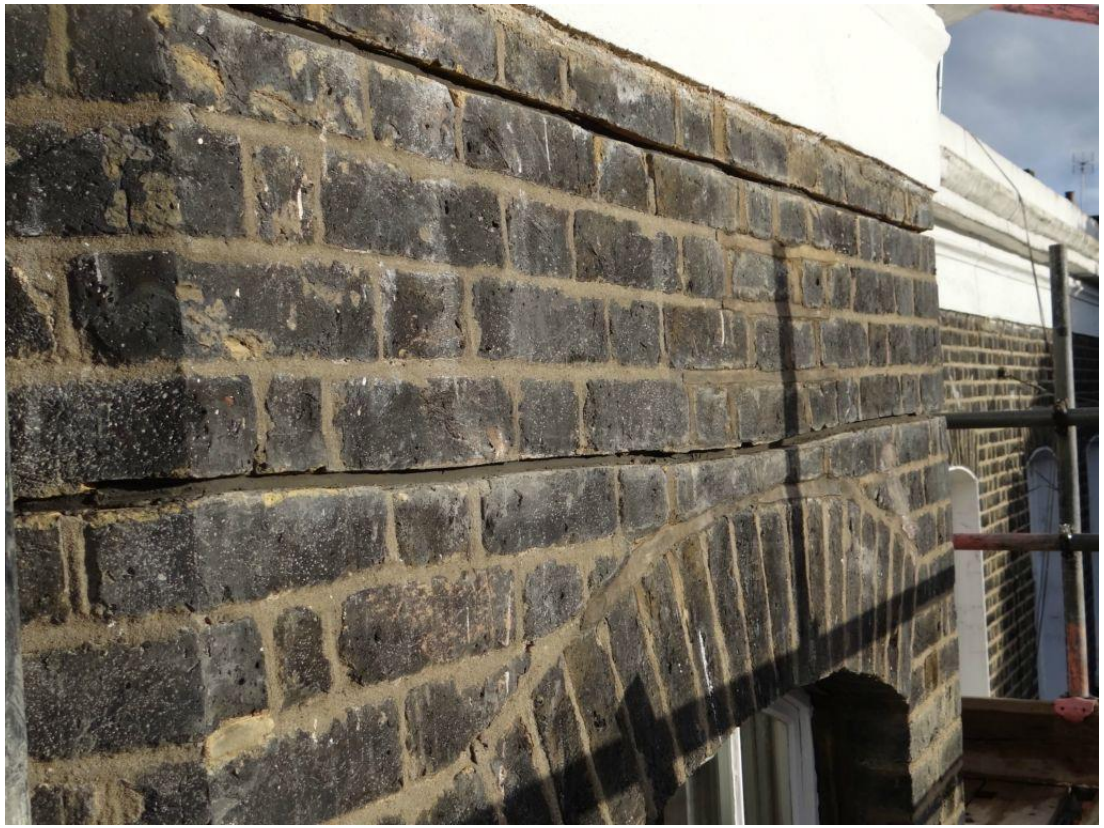
What it looks like...



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Archways

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Sagging Lintels

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Flashing Repair

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Lintel Replacement

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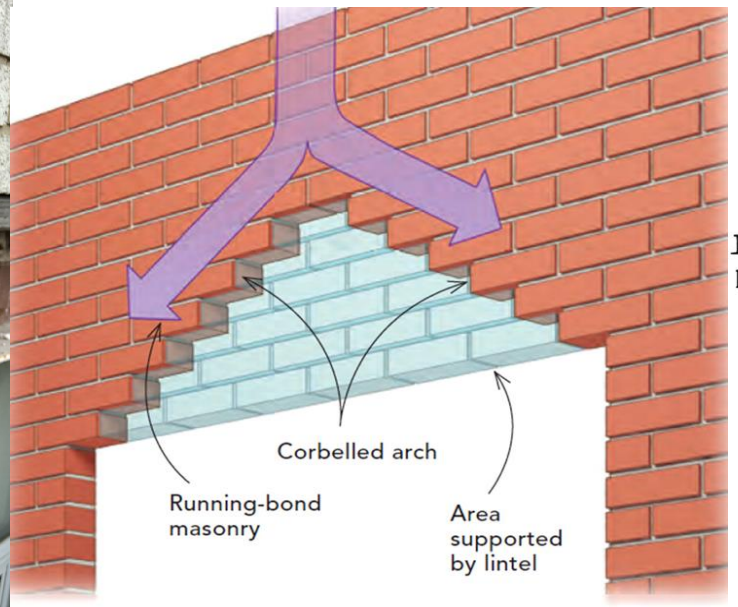
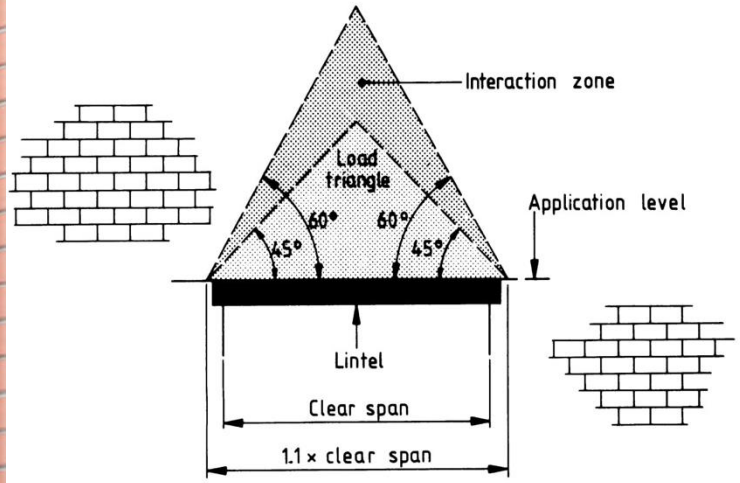
Lintel Replacement





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What is the cost of the Helical Masonry Beaming compared to replacing the lintel and brick?

On average replacing a steel lintel and brick runs about **$195 per lineal foot** (3 courses of brick).

On average Helical Masonry Beaming runs about **$70 per lineal foot.**

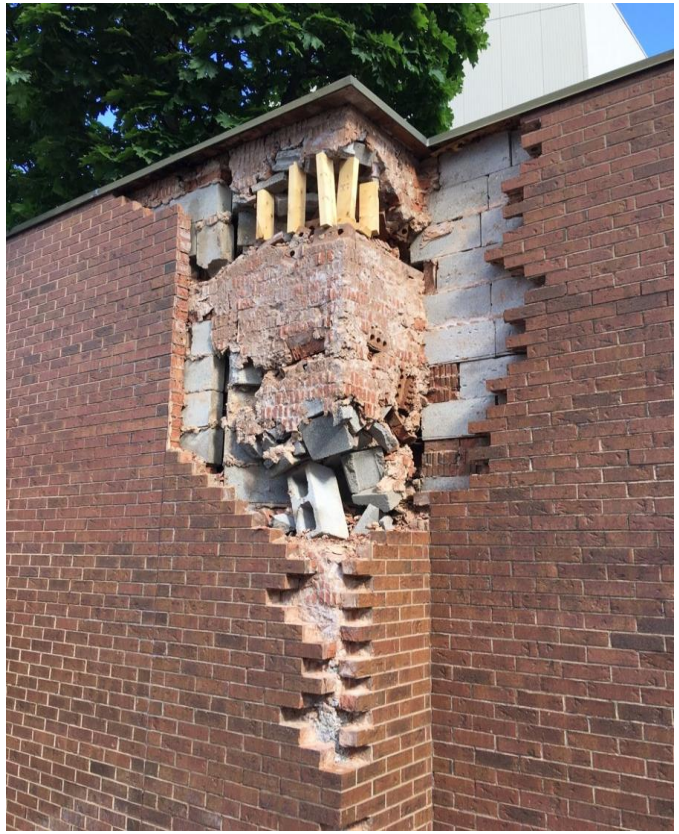
So, to replace a lintel and brick on a 5-foot window would be $975.

Helical Masonry Beaming for the same window would be $350. **Less than half the cost!**

Why else would I use this system?

One word: **SAFETY!**

When removing brick from a wall, the technician assumes that the wall is sound. BUT…



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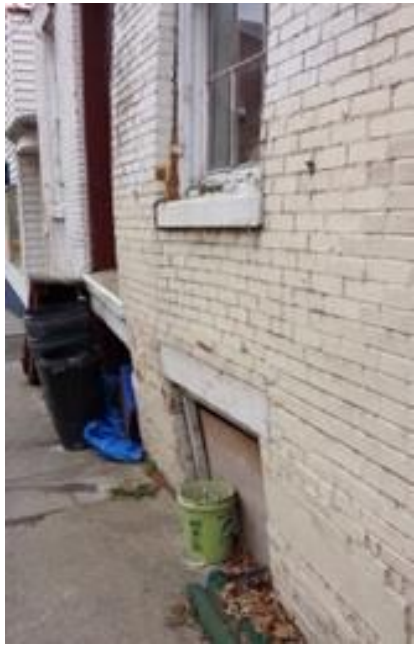
Unreinforced

Reinforced with
1x 6mm Stitch-Tie Bar

The wall could have issues that could lead to a partial collapse

There could be no existing wall ties

Cracks in the brick work



Wall could be under strain

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Reinforce the brick masonry before brick is removed.

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How does helical masonry beaming get installed?

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Step 1: Measure

Step 2: Cut out Joints

Step 3: Wash out debris

Step 4: Mix Thixotropic Grout

- 3900 psi compressive strength after 28 days.
- Reaches 30% compressive strength after 24 hours.

Step 5: Inject first bead of grout

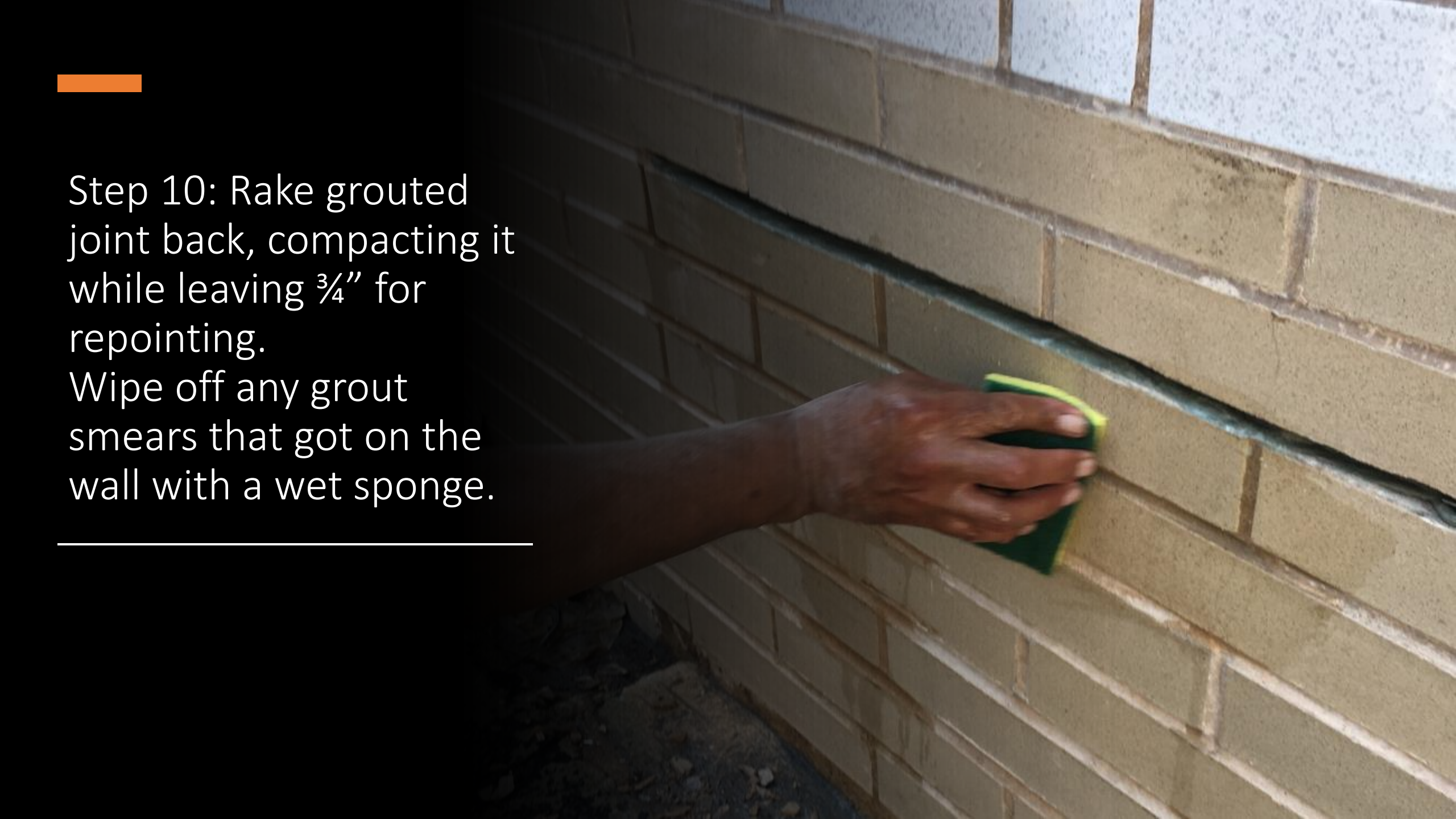
Step 6:
Insert first helical bar into grout.

Step 7: Insert the second bead of grout over the first helical bar.

Step 8: Insert the second helical bar into the grout.

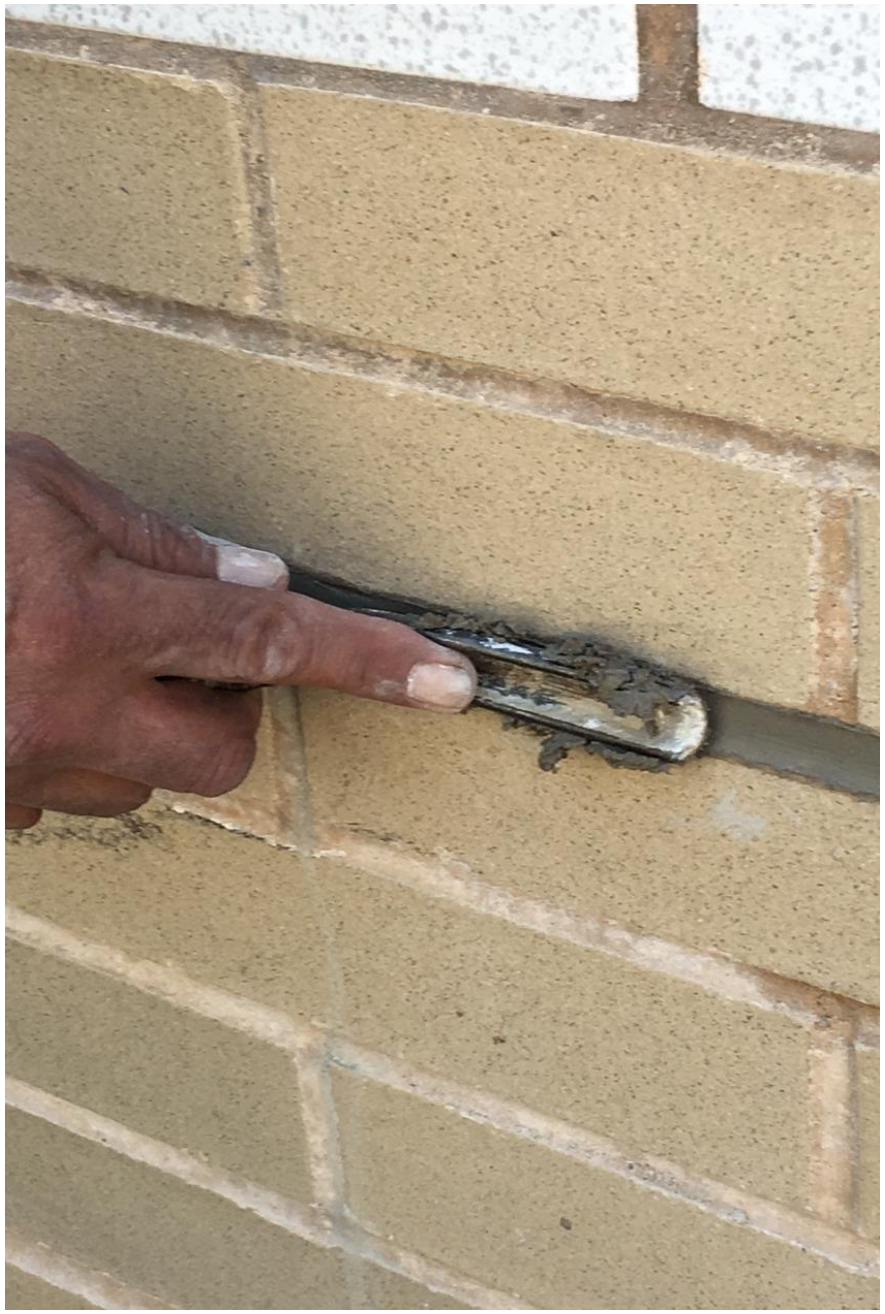
Step 9: Inject a final bead of grout over the second helical bar.

Step 10: Rake grouted joint back, compacting it while leaving ¾” for repointing.
Wipe off any grout smears that got on the wall with a wet sponge.



Step 11: Match the mortar

Because we don’t want to see this look!



Step 12: Repoint the joints

Step 13: When mortar is cured, wash bricks and mortar with a cleaner

Step 14: Have a beer with your friends, you're done!

PROSOCO Anchoring Team

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