

VOIDSPAN PHLc Gravity Feed and PHLc70 Injection Grout



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VOIDSPAN PHLc Grouts/ Selection Guide

	<i>#100 SERIES</i> PHL MORTAR BINDER	<i>#200 SERIES</i> PHLc MORTAR BINDER	<i>#300 SERIES</i> PHLc FINE POINTING MORTAR	<i>#400 SERIES</i> PHLc70 CRACK FILLER	<i>#500 SERIES</i> PHLc GRAVITY FEED GROUT	<i>#600 SERIES</i> PHLc70 INJECTION GROUT
CRACK REPAIR AND RE-BONDING SEPARATED MASONRY						
• SURFACE FILLING OF CRACKS AND CRAZING			For filling gaps between 3 mm (1/8") and 8 mm (5/16") wide.	For filling gaps up to 6 mm (1/4") wide		
• PRESSURE INJECTING CRACKS AND CAVITIES						For use with grouting ports and VoidSpan Port Anchors
• GRAVITY FEED GROUTING OF CRACKS AND CAVITIES					For filling gaps of 10 mm (3/8") or greater. May be blended with peastone for gaps of 75 mm (3") or greater.	For filling gaps of 3 mm (1/8") to 25 mm (1"). Gaps down to 1 mm (3/64") require special procedures.
• ADHERING LOOSE FRAGMENTS; BONDING FITTED DUTCHMEN					For bond line widths down to 2 mm (3/32") when mixed to a paste.	For bond line widths down to 1 mm (3/64") when mixed to a paste.



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	#100 SERIES PHL MORTAR BINDER	#200 SERIES PHLc MORTAR BINDER	#300 SERIES PHLc FINE POINTING MORTAR	#400 SERIES PHLc70 CRACK FILLER	#500 SERIES PHLc GRAVITY FEED GROUT	#600 SERIES PHLc70 INJECTION GROUT
REBUILDING UNIT MASONRY REPOINTING						
• UNIT MASONRY RECONSTRUCTION		For most structures with hydraulic lime and low cement/ high lime mortar blends.	For structures with less than 8 mm (5/16") mortar joint width.			
• CUTTING AND POINTING	For pointing over lime-based bedding mortars, and for use with low strength masonry units and adobe.	For pointing over hydraulic lime and cement-lime bedding mortars, with moderate to high strength masonry units.	For pointing of joints less than 8 mm (5/16") wide (butter joints).			
• FILLING OF COLLAR JOINTS; BONDING BETWEEN RECONSTRUCTED WYTHES					For filling gaps of 10 mm (3/8") or greater. May be blended with peastone for gaps of 75 mm (3") or greater.	For filling gaps of 3 mm (1/8") to 25 mm (1").



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VOIDSPAN PHLc Grouts/ PHLc Gravity Feed Grout

VOIDSPAN PHLc Gravity Feed Grout is a breathable, ultra-low shrinkage, flowable, self-consolidating grout for use in filling cracks and voids in older masonry structures. Based on a pozzolanic hydraulic lime as per ASTM C1707, it is a low-to-moderate strength adhesive, filler and mortar replacement material. Uses Include:

- Gravity feeding of cracks and voids in mass masonry construction of 100 mm (4”) or greater in width.
- Gravity feeding and low pressure pump filling of cracks as narrow as 6 mm (1/4”) in width.



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VOIDSPAN PHLc Grouts/ PHLc70 Injection Grout

VOIDSPAN PHLc70 Injection Grout (formerly CG70) is a breathable, ultra-low shrinkage, flowable, self-consolidating fine grout for use in injection and gravity filling of cracks and defects in older masonry elements as well as for structural bonding of delaminated mass masonry leaves. Based on a pozzolanic hydraulic lime “PHLc” as per ASTM C1707, it is a low-to-moderate strength adhesive, filler and fine mortar replacement material.

Uses Include:

- Gravity feeding and fine injection filling of cracks as narrow as 1.5 mm (1/16”) in width.
- Low pressure bulk injection of cracks and voids in mass masonry construction using cavity-grouting **VoidSpan Port Anchors**.



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VOIDSPAN PHLc Grouts/ Strength Development



**Compression
Testing**

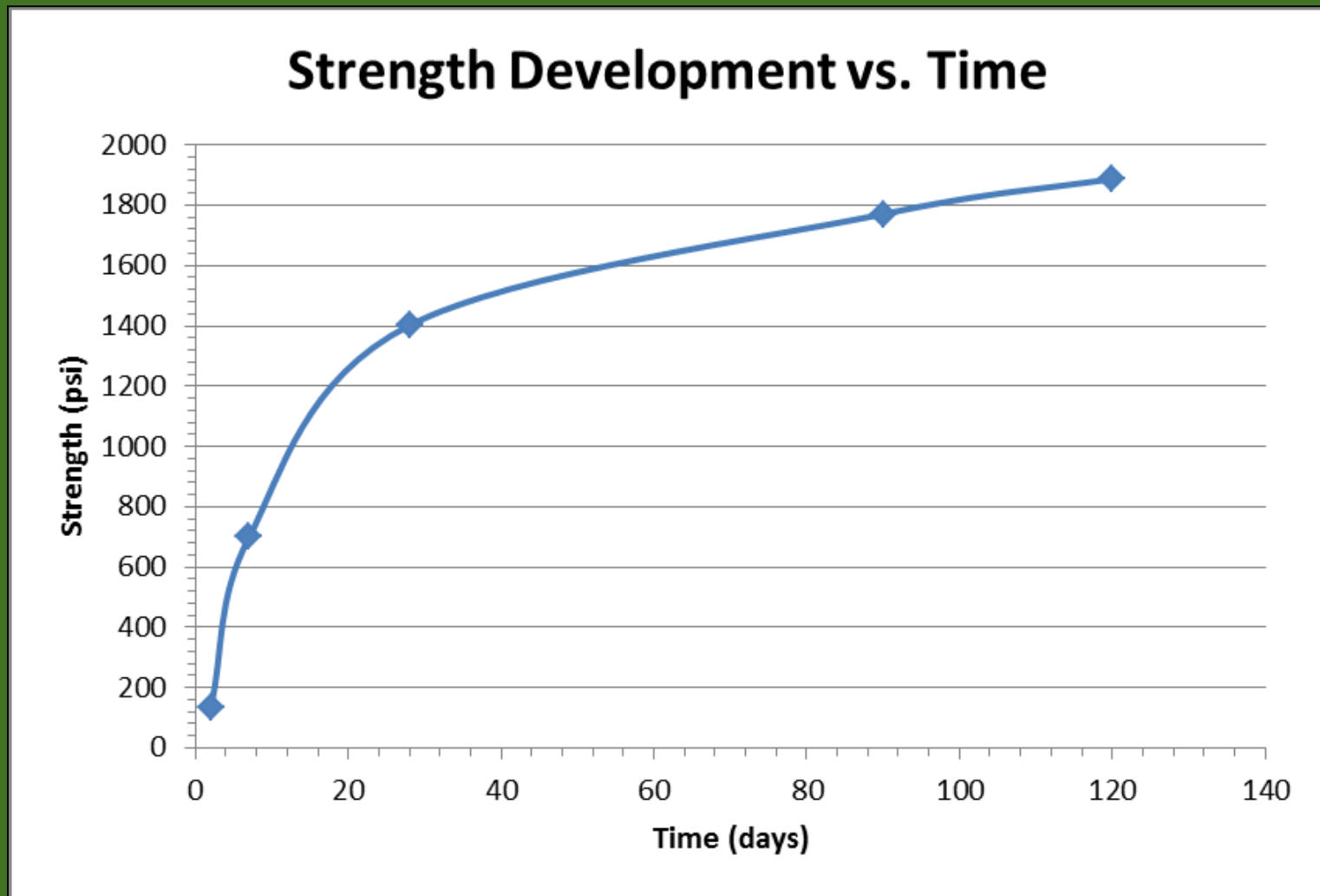


**Splitting Tensile
Testing**



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VOIDSPAN PHLc Grouts/ Strength Development

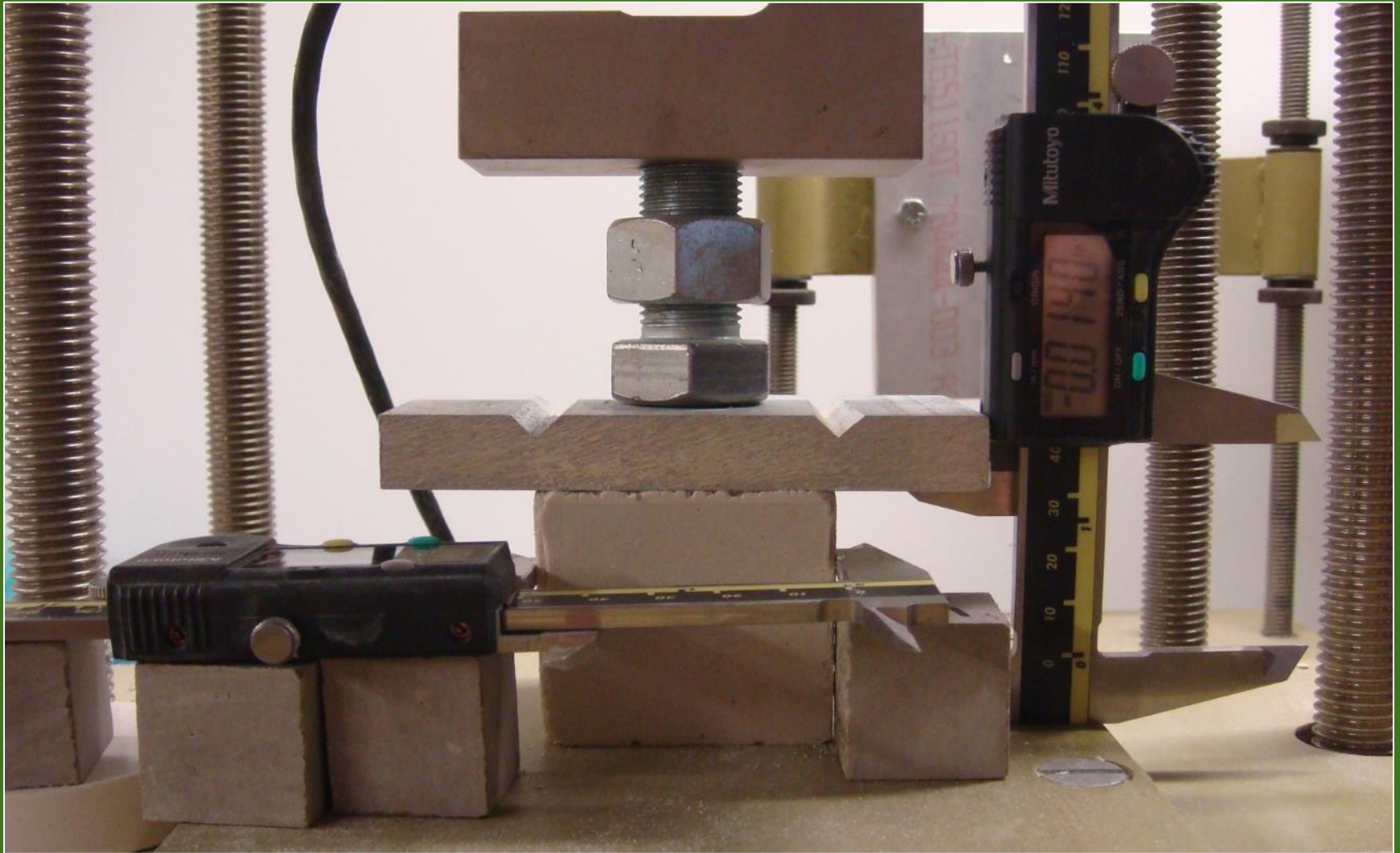


**Strength Development Curve for
VOIDSPAN PHLc Grout**



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Repair Products with PHL and PHLc Binders



Poisson's Ratio Testing in Semi-Hardened State (44 hours)



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VOIDSPAN PHLc Grouts/ Strength Development

Compressive Strength:

135 psi at 2-days per ASTM C109

700 psi at 7-days

1400 psi at 28-days

1770 psi at 90-days

1900 psi at 120-days

Tensile Strength:

20 psi at 2-days per ASTM D3967

45 psi at 7-days

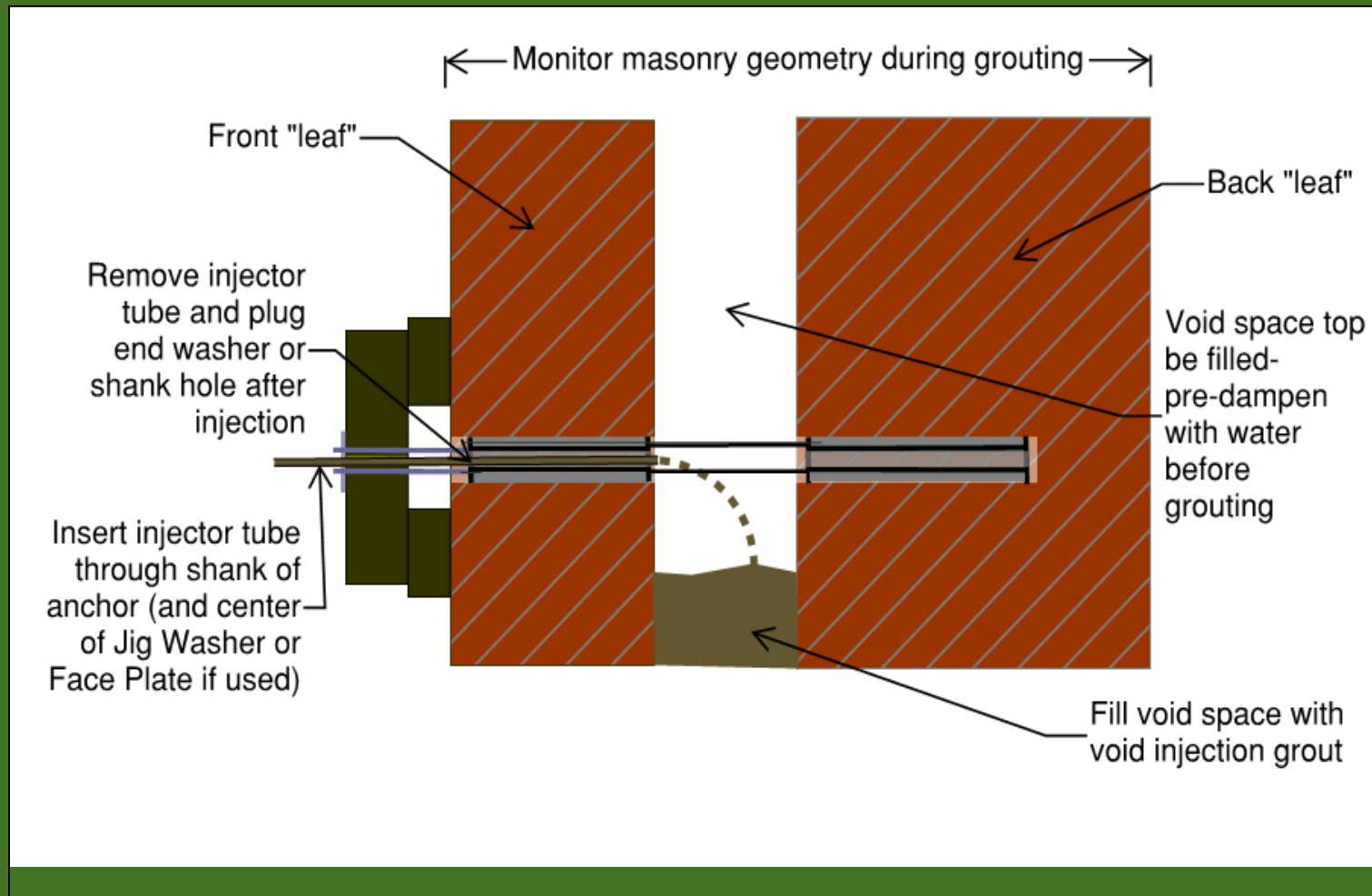
140 psi at 28-days

250 psi at 120-days



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VOIDSPAN PHLc Grouts/ Strength Development

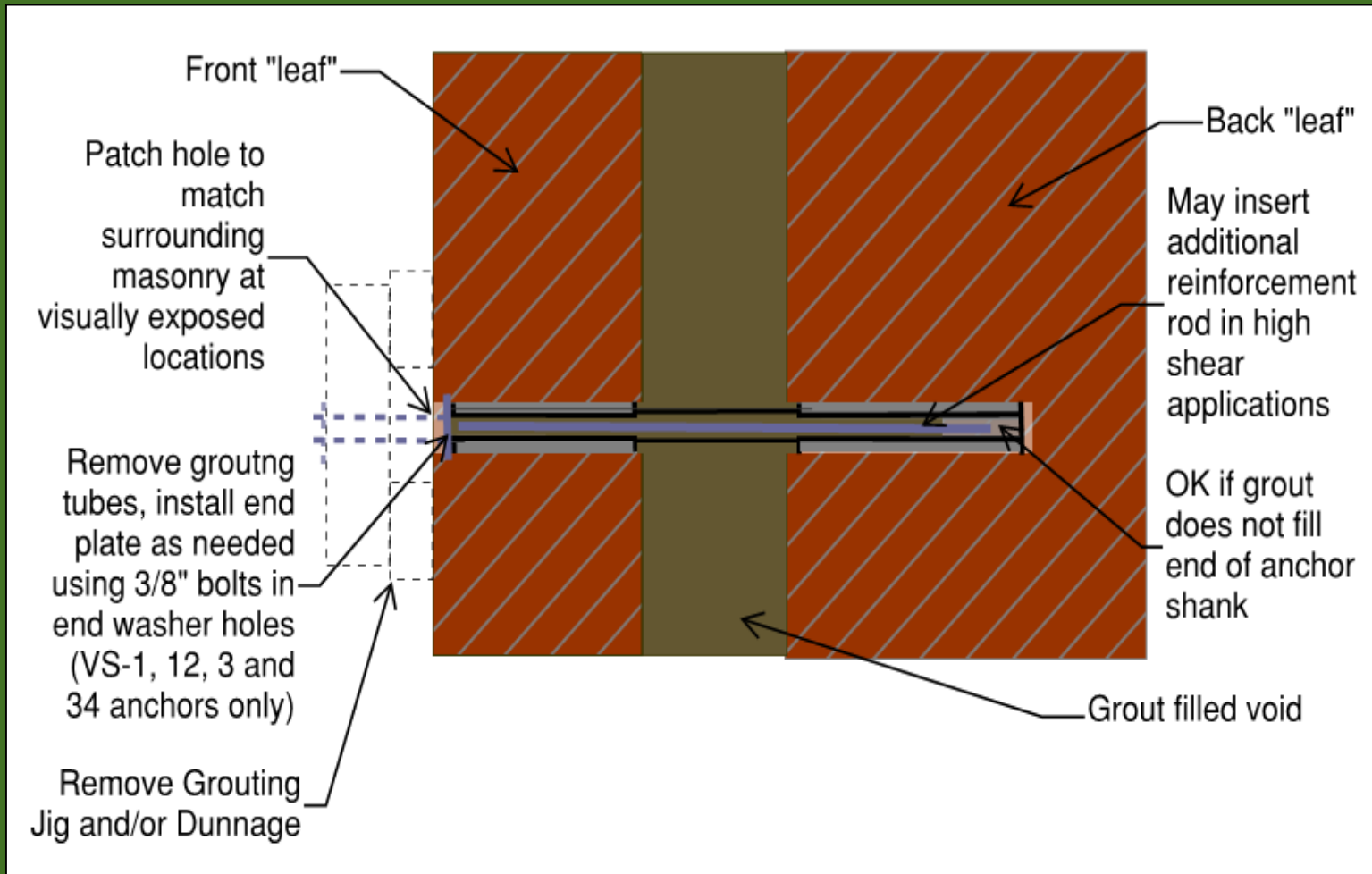


**Typical Grout Installation via
VOIDSPAN Port Anchor**



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VOIDSPAN PHLc Grouts/ Strength Development

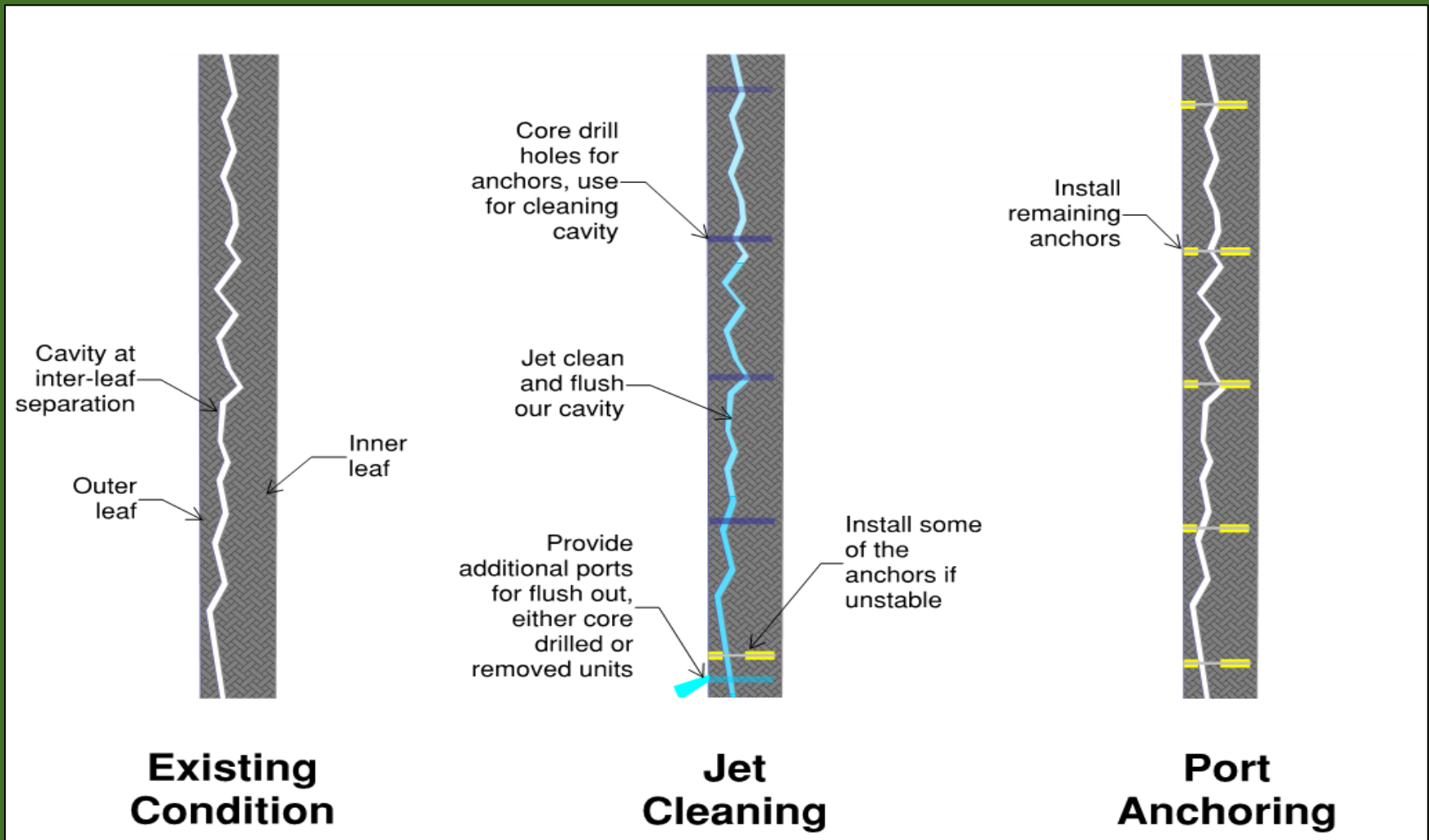


Post Grouted Condition



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VOIDSPAN PHLc Grouts/ Strength Development

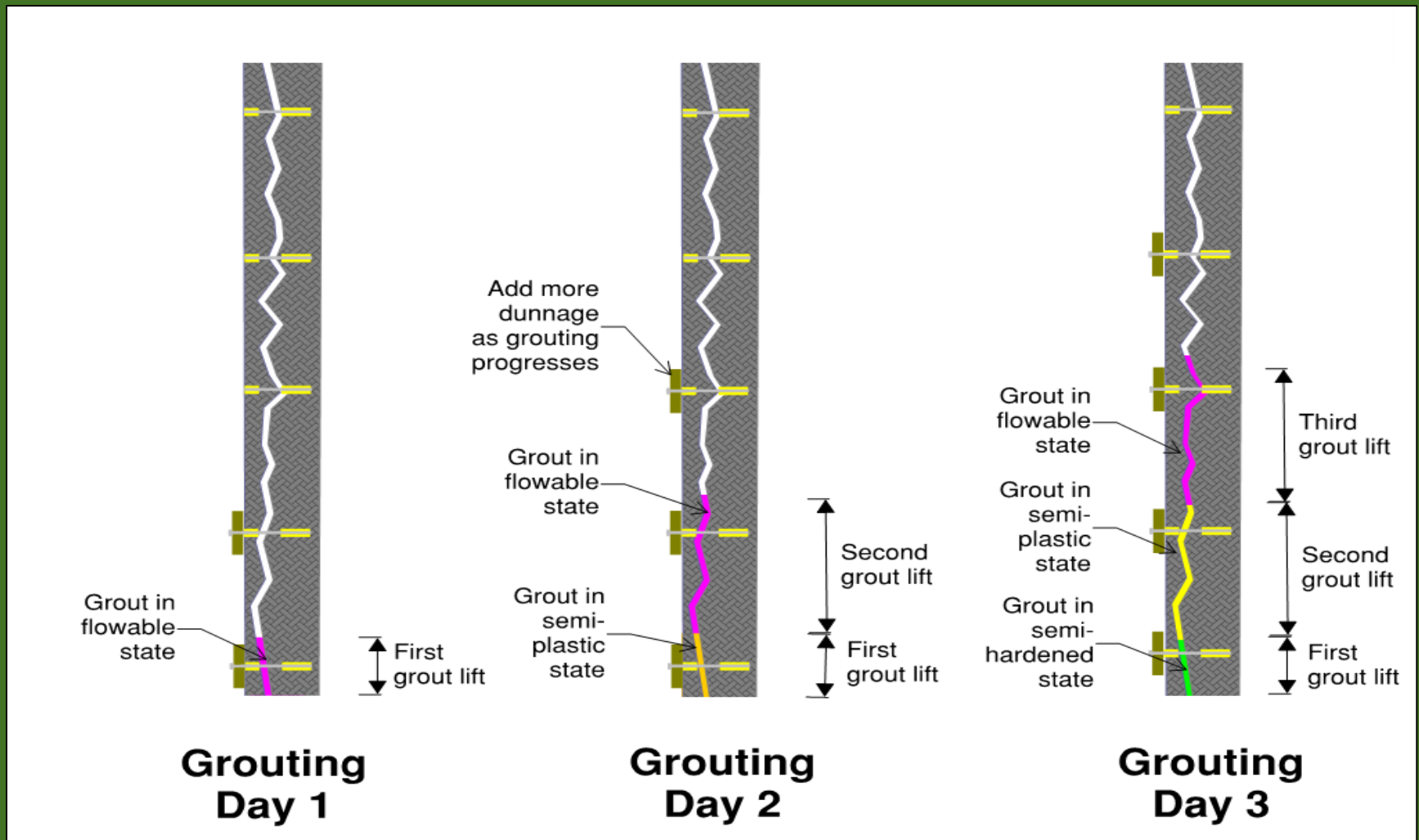


Grouting Sequence with Port Anchors



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VOIDSPAN PHLc Grouts/ Strength Development

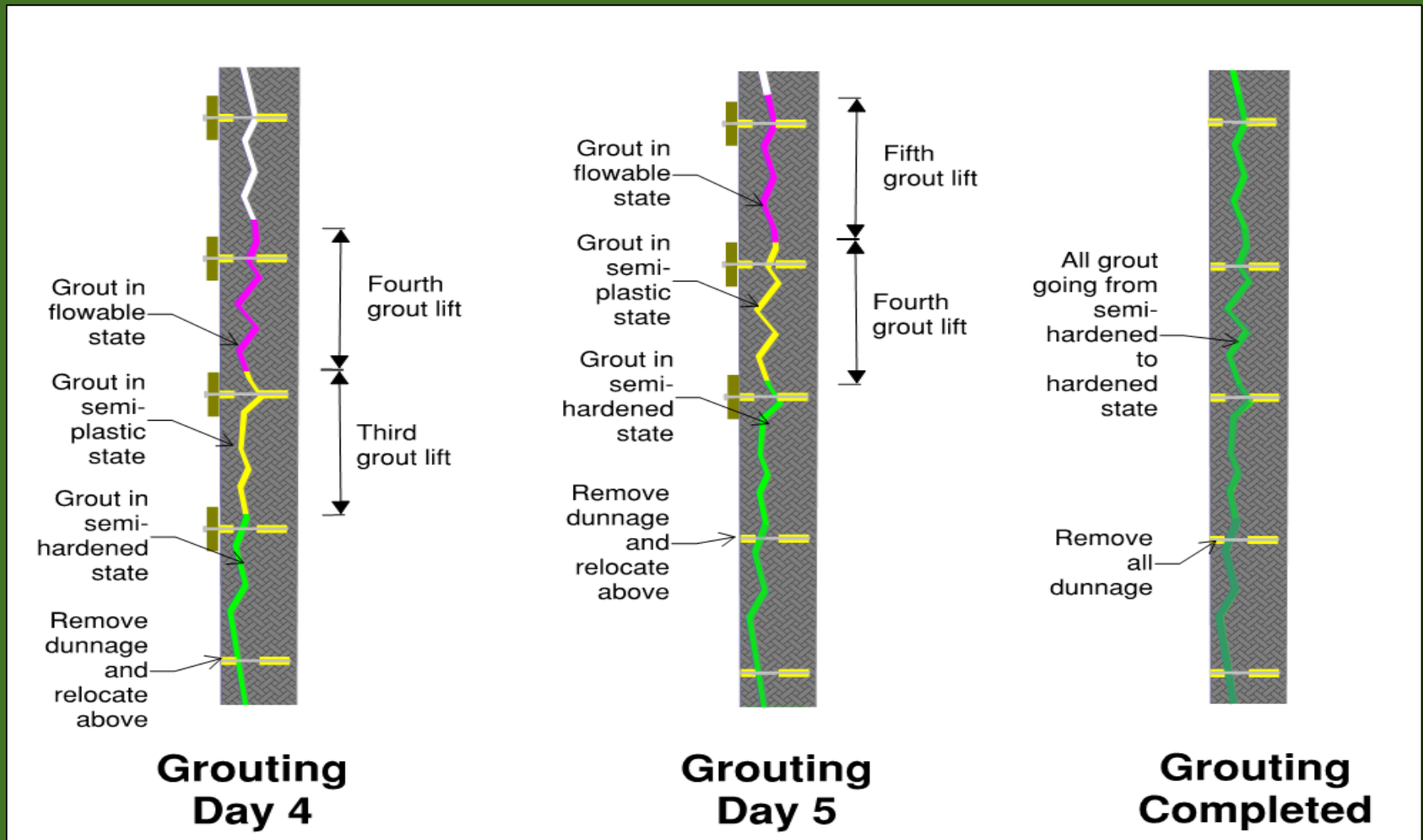


Grouting Sequence with Port Anchors



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VOIDSPAN PHLc Grouts/ Strength Development

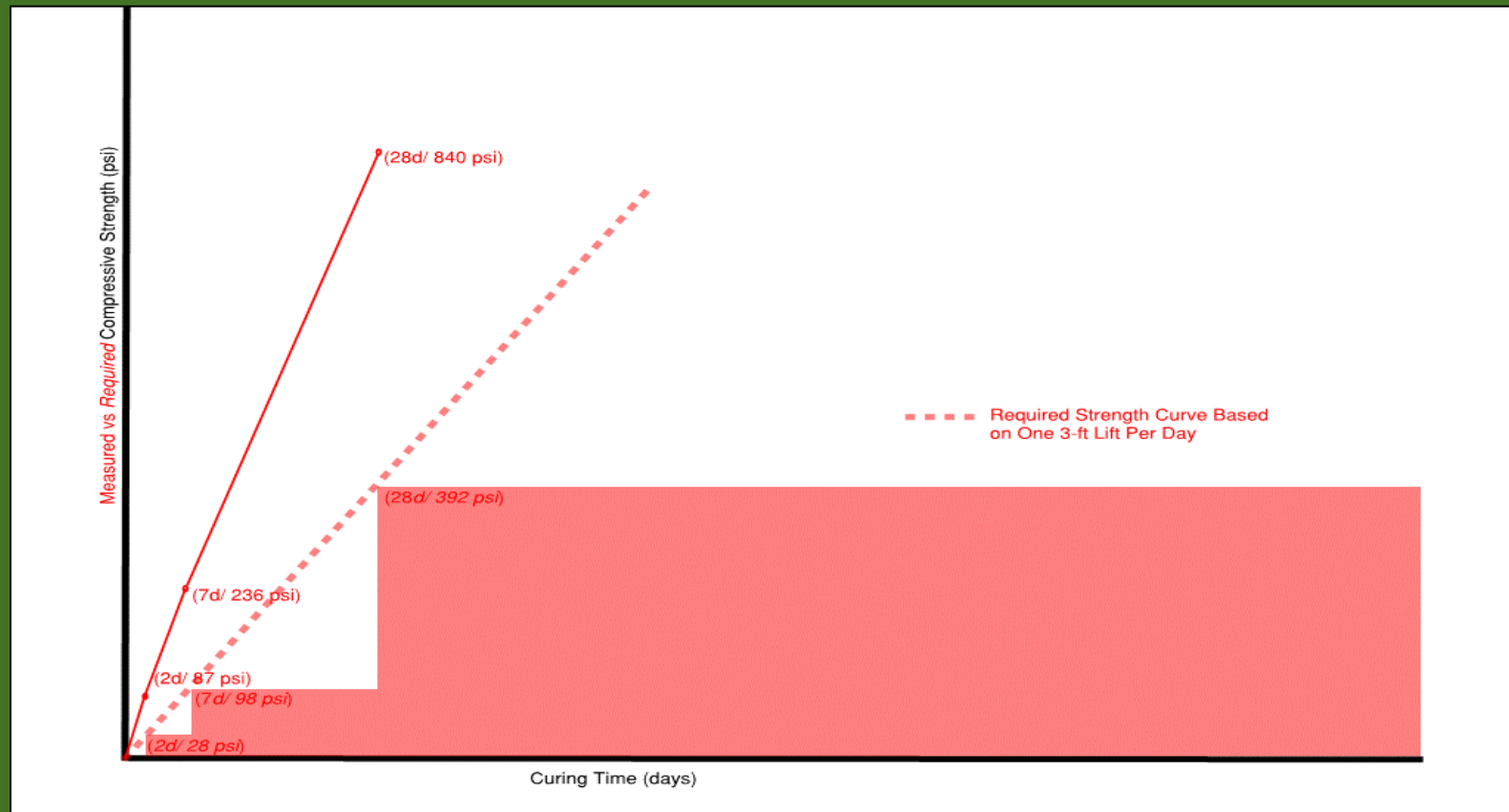


Grouting Sequence with Port Anchors



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VOIDSPAN PHLc Grouts/ Strength Development



Strength Development with Time

Our PHLc Gravity Feed and PHLc70 Injection Grouts have sufficient strength gain to support two meters of fluid grout overburden after 40 hours without significant deformation.



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VOIDSPAN PHLc Grouts/ Adhesive Strength

Adhesion Testing



**VOIDSPAN
PHLc Gavity
Feed Grout**

The adhesive strength with many substrates exceeds the cohesive strengths, ensuring a rough interface contact surface even after cracking, thereby maintaining friction.



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VOIDSPAN PHLc Grouts/ Ultra-Low Shrinkage

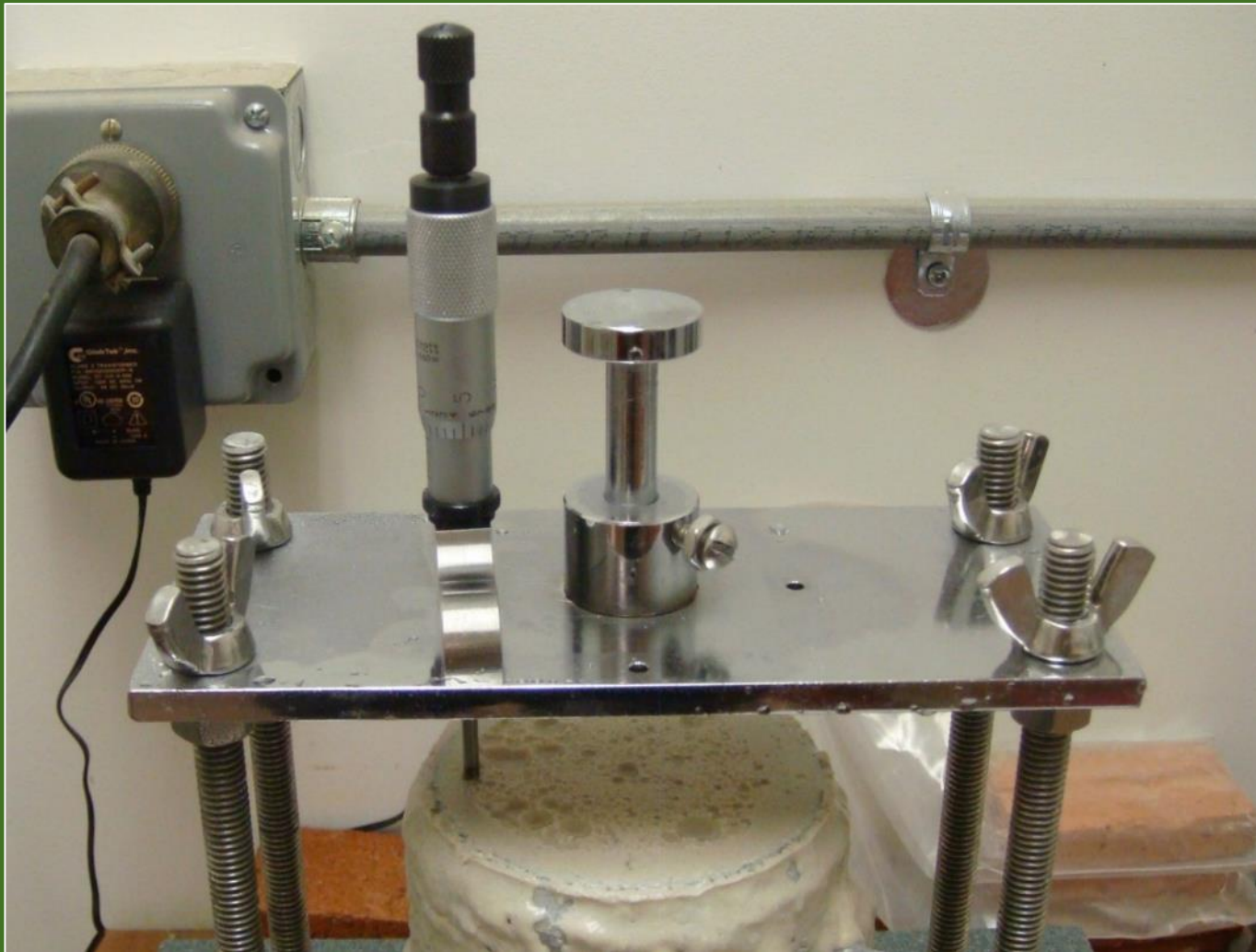


Shrinkage trials in 4" CMU



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VOIDSPAN PHLc Grouts/ Ultra-Low Shrinkage

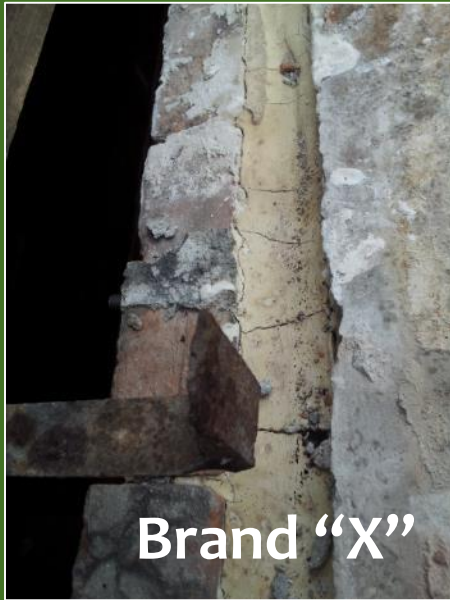


Height Change per ASTM C1090



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VOIDSPAN PHLc Grouts/ Ultra-Low Shrinkage



Images of a Trial Installation of the Three Leading Restoration Grouts

The high adhesion and solids content of our PHLc Grouts all but eliminates shrinkage while the lack of a shrinkage, while the lack of a shrinkage compensator avoids the expansion that can sometimes be damaging.



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VOIDSPAN PHLc Grouts/ Flowability



The naturally occurring roundness and the extremely fine particle size of our sand makes the aggregate in our PHLc Grouts act like microscopic ball bearings. The post-sifted sand in our PHLc-70 injection grout is even finer.

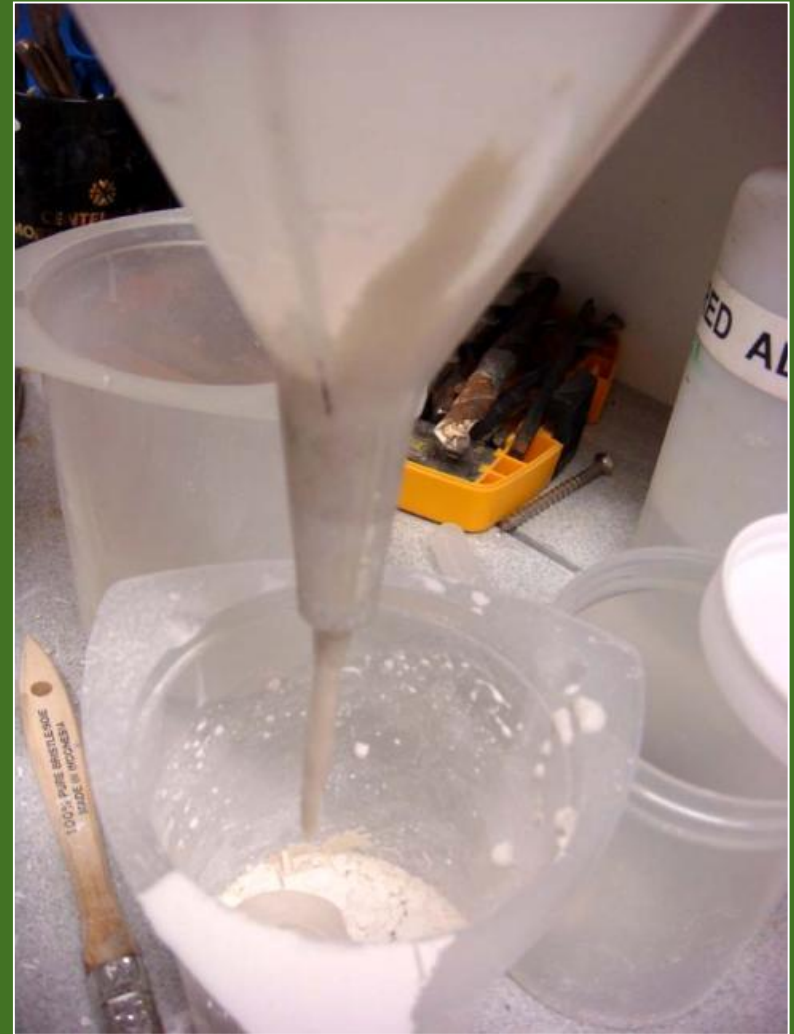


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VOIDSPAN PHLc Grouts/ Flowability



**Flow Test against
Dry Plywood**



**Flow Test
with a Funnel**



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VOIDSPAN PHLc Grouts/ Flowability



Efflux Testing / ASTM C939



Flow Table Testing /
ASTM C827



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VOIDSPAN PHLc Grouts/ Flowability



Consolidation Testing



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VOIDSPAN PHLc Grouts/ W. V. Permeability

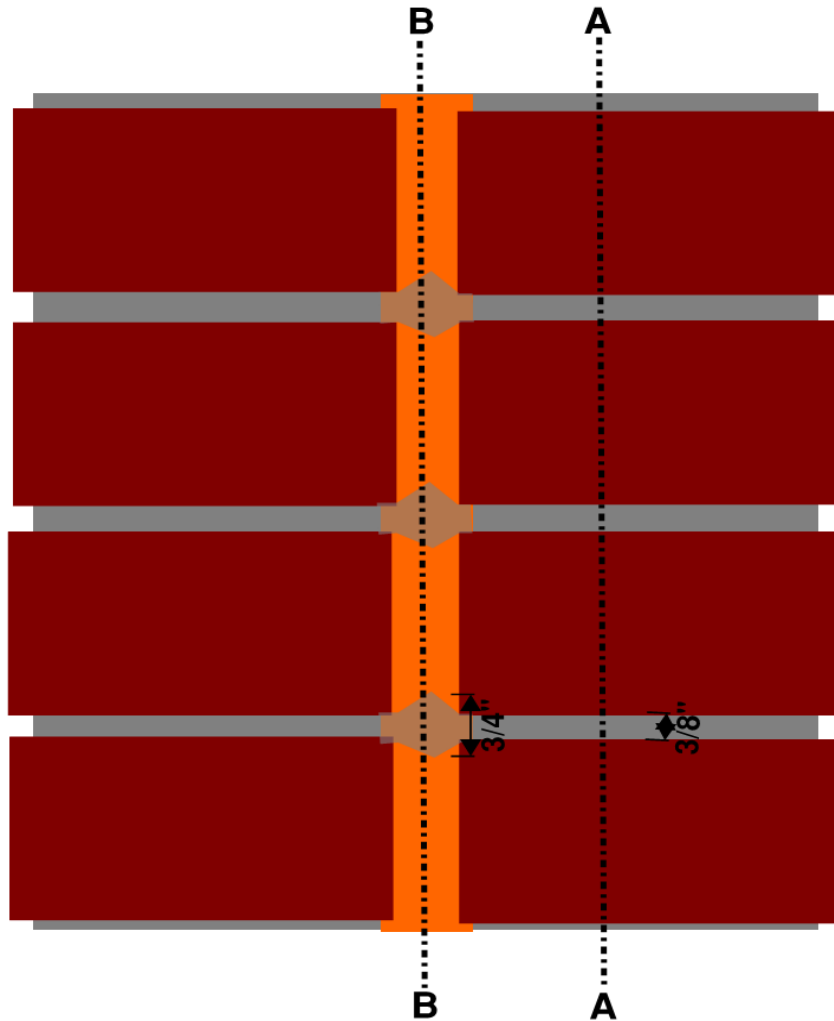


Water Vapor Permeability Testing



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VOIDSPAN PHLc Grouts/ W. V. Permeability



Assume the following relative WV Permeabilities:

Brick = 0.33 g / sq. m / hr (typical assumed)
 Old Mortar = 2.6 g / sq. m / hr (1 C : 2 L : 4.5 S)
 New Grout = 1.9 g / sq. m / hr (VS PHLc Grout)

Across brick joint A-A

Area of brick module = $8\frac{2}{3} \times 8 = 21.3$ sq. in.

Area of brick = $2.34 \times 7.625 = 17.8$ sq. in.

Area of mortar = $21.3 - 17.8 = 3.5$ sq. in.

Average WV Permeability for module area=

$(17.8 \times 0.33 + 3.5 \times 2.6) / 21.3 = \mathbf{0.70}$ g / sq. m / hr

Across grouted collar joint B-B

If we assume the effective width through which vapor passes in the middle of the joint is double the joint width due to natural spread, then the average width of transfer zone over the joint becomes 1.5 x the joint width. Lets also assume that between these zones we have the same WVP factor as the brick, since vapor is retarded in these areas by them.

Area of brick module = $8\frac{2}{3} \times 8 = 21.3$ sq. in.

Area between joint zone = $2.10 \times 7.44 = 15.7$ sq. in.

Area of mortar = $21.3 - 15.7 = 5.6$ sq. in.

Average WV Permeability for module area=

$(15.7 \times 0.33 + 5.6 \times 1.9) / 21.3 = \mathbf{0.74}$ g / sq. m / hr

Under the above assumptions, this would mean that with the approximately 25% less permeable grout in the collar joint than the mortar, the overall WVP of the grouted cavity still would not govern the assembly.

Water Vapor Flow Transport within Wall



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VOIDSPAN PHLc Grouts/ Freeze-Thaw Resistance

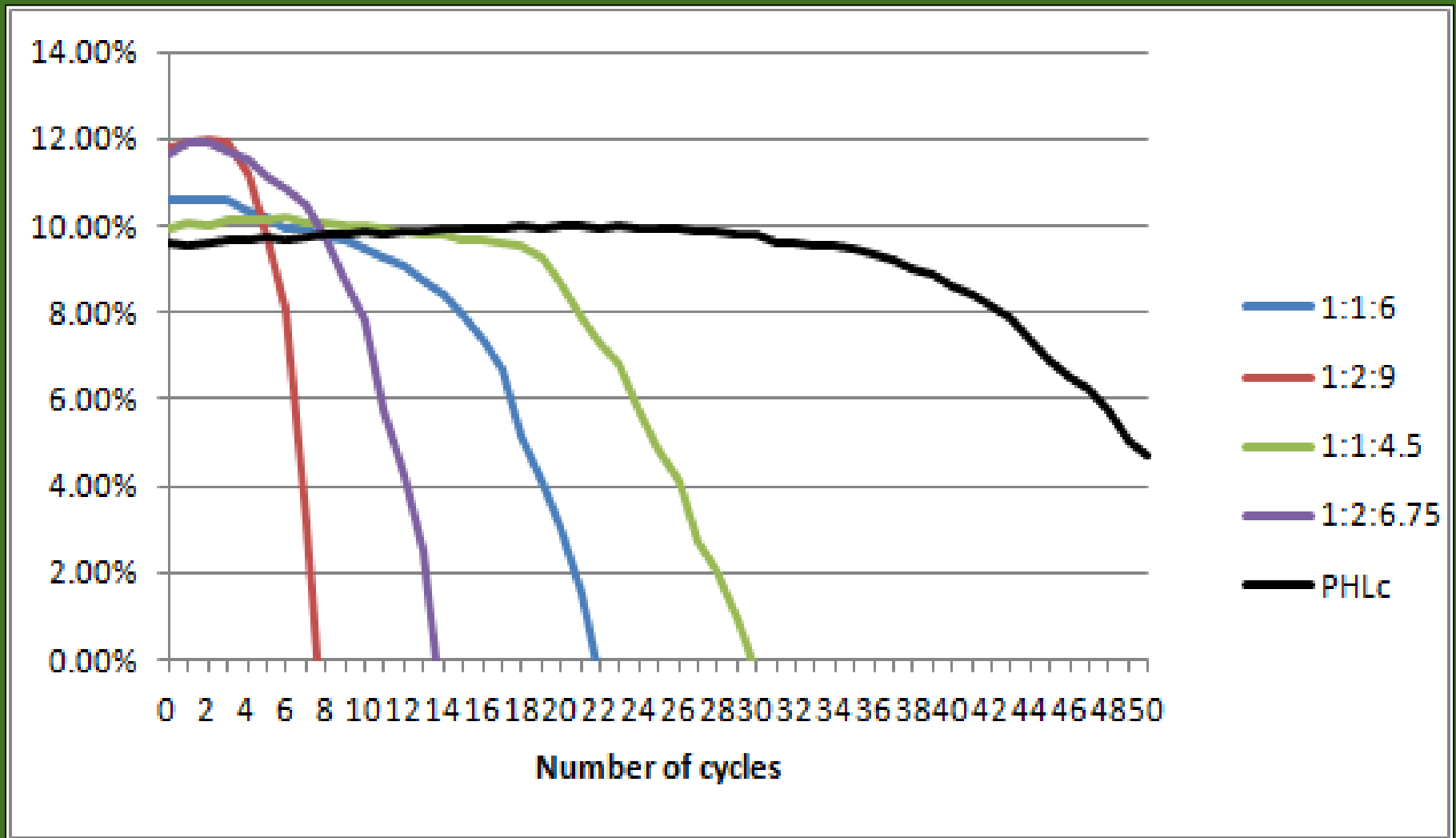


Freeze-Thaw Samples



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VOIDSPAN PHLc Grouts/ Freeze-Thaw Resistance



Comparative Freeze-Thaw Results



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VOIDSPAN PHLc Grouts/ Properties

Cement Content by weight of Binder:	< 15% meeting ASTM C1707 as a “PHLc”
Chloride Content by weight of Binder:	0.008% (far below the 0.06% allowed by the ACI for Prestressed Concrete)
Flowability:	135% per ASTM C230
Drying Shrinkage/Expansion:	-0.06% per ASTM C1090
Air Content:	N/A (not intentionally air entrained)
Standard Curing Time (CT):	120-days per ASTM C1713
Water Vapor permeability: (modified)	1.9 g / sq. m / hr per ASTM E96



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VOIDSPAN PHLc Grouts/ Expanded Shale Aggregate



VOIDSPAN *EXTEND* in Raw Form and in Grout



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VOIDSPAN PHLc Grouts/ Expanded Shale Aggregate

VOIDSPAN EXTEND Aggregate is a vacuum pre-saturated expanded shale to be used as an economical extender for our #500 series **PHLc Gravity Feed Grout**, which is our standard, ultra-low-shrinkage, flowable self-consolidating grout for gravity feeding of deep cracks and voids in older masonry structures.

VOIDSPAN EXTEND Aggregate can be mixed volumetrically on a 1:1.5 grout to aggregate ratio to create an aggregated, flowable grout, or up to a 1:2 grout to aggregate ratio to create an ultra-low shrinkage PHLc Concrete.



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VOIDSPAN PHLc Grouts/ Expanded Shale Aggregate

With approximately the same specific gravity as our grout, our expanded shale will float in suspension to allow the combined material to flow freely without segregation or over-buoyancy. When made into a concrete, the resulting material can be lightly tamped or vibrated into place. Because of its inherent moisture, our pre-saturated aggregate promotes Internal Curing of the PHLc grout, resulting in a more rapid strength gain.

VoidSpan EXTEND Aggregate meets ASTM C330 “Standard Specification for Lightweight Aggregates for Structural Concrete” and is available in 5 gallon pails and 3,000 lb. “Super Sacks”.



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VOIDSPAN PHLc Grouts/ Installation Photos



**St. Josephs Church
New London, CT**



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VOIDSPAN PHLc Grouts/ Installation Photos



PHLc Gravity Feed Grout being used to fill collar joints behind reconstructed stone facing. Assures a fully bonded collar joint while the pozzolan eliminates the possibility of Lime bleed.



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VOIDSPAN PHLc Grouts/ Installation Photos

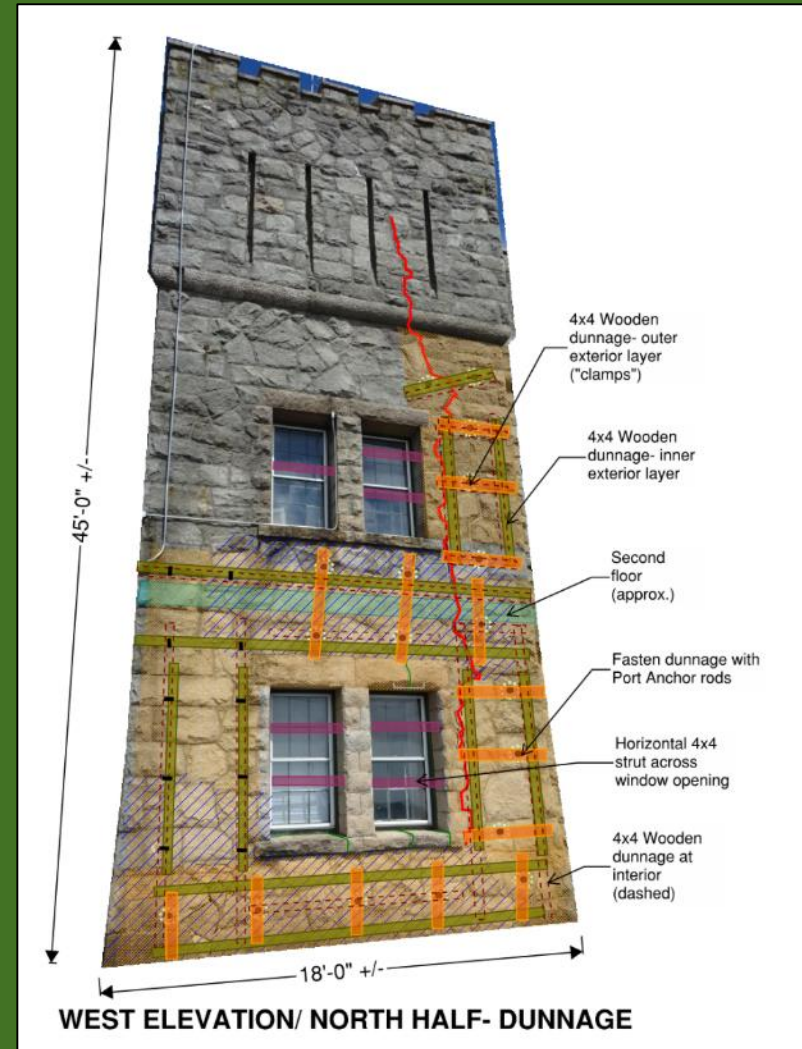
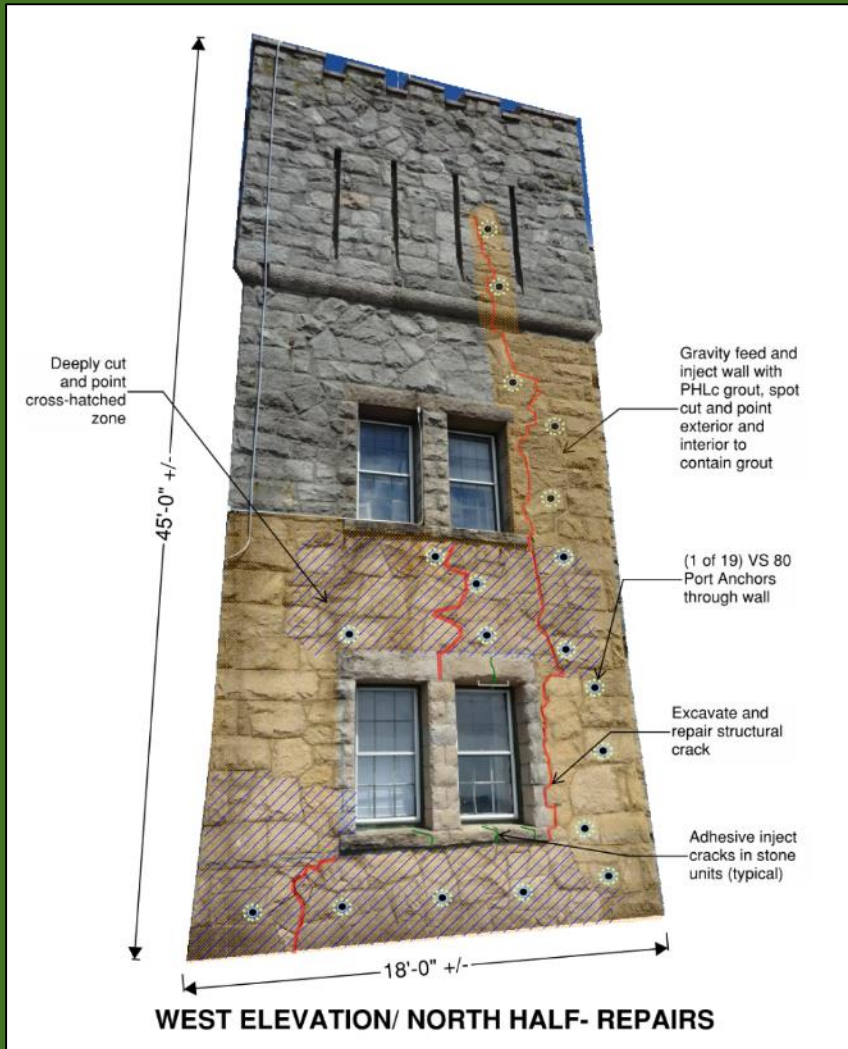


Bristol Maritime Armory
Bristol, RI



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VOIDSPAN PHLc Grouts/ Installation Photos



One of the severely voided granite masonry walls of the Bristol Armory to be consolidated with PHLc Grouts. The walls' poor conditions required an integral dunnage system.



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VOIDSPAN PHLc Grouts/ Installation Photos



Our **PHLc70 Injection Grout** being injected into the wall via VOIDSPAN **Port Anchors**. Additional PHLc Gravity Feed Grout was fed via ports into open cavities, also using a pressure pot.



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Thank You!

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