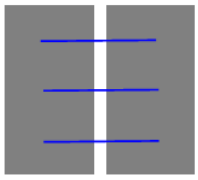
VoidSpan System

STRUCTURAL FUNCTION

The intended purpose of the ***VoidSpan Port Anchor*** *Grout Injection System* is to restore the composite integrity of a mass masonry system that has been unintentionally separated into two or more layers or needs to be solidified and confined due to an unacceptably high percentage of voids. The Structural Function of the ***VoidSpan Port Anchor*** *Grouting System* is to achieve the following:

Maintain the Positions of Detached Layers



Structural masonry elements such as walls and piers that have longitudinally split unto multiple layers are made significantly weaker than when they were solid. For example, a 609.6 mm (24”) thick wall split down the center into two 304.8 mm (12”) layers has half of the total bending strength and buckling resistance as it did as one 609.6 mm (24”) thick unit. Laterally tying these half-thicknesses together would keep them from pulling further apart, but would offer little improvement to the wall’s overall stability, as both halves would simply buckle or bend in the same direction.

If the wall were split into layers of unequal thickness, which is more common, such as an 203.2 mm (8”) layer and a 406.4 mm (16”) layer, the combined bending resistance would still be about half that of the solid 609.6 mm (24”). The 203.2 mm (8”) layer, however, would be much less stable than the 406.4 mm (16”), and would in this case benefit by being laterally tied to it, although the function of the wall as a whole would not be improved.

VoidSpan Port Anchors have *Cintec* socks and/or mechanical attachments at each end that allow it to act in tension. Where there are socks at both ends they can act in compression. Although the fastening of the anchor ends does not actually bond the masonry back together, it is helpful in at least tying the layers together.

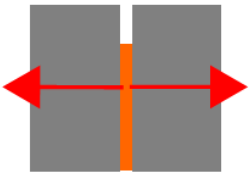
Provide a Pathway into the Void Structure

VoidSpan Port Anchors have integral 12.7 mm (½") ID grouting ports that extend from the outer ends of the anchors. These run along or within the shank to create an open pathway through which to inject internal voids.

In open shank anchors they can also be used for jet cleaning of the voids, for evacuating jet water and fine particles, and pre-dampening the voids prior to void filling.

In collar joint applications, it is especially critical for the injected void filling grout to completely fill and bond to clean, pre-dampened, non-friable surfaces within at least a 152.4 mm (6") minimum radius from centerline of each anchor. Beyond these critical zones, full compaction and bond are helpful, but not necessary for proper performance. VoidSpan is the only system that provides optimum access, cleaning and grout compaction where they are needed most- surrounding the anchors.

Resist Temporary Grouting Pressures



Injection of grout between separated layers of masonry create lateral pressures that are roughly equal to the fluid weight of the grout vertical "column" of wet grout, or typically between 54.43 kg (120 lbs) and 63.5 kg (140 lbs) per square foot (psf) per foot of vertical height.

The ***VoidSpan Port Anchor*** system has been designed to provide for daily 3-foot lifts of 120 pound per cubic foot (pcf) grout when spaced on a 0.91 meters (3-foot) by 0.91 meters (3-foot) pattern, based upon the assumption that the grout has sufficient strength to support the fluid surcharge weight of two lifts after 40-hours (just under two days). With the line of anchors centered on the first lift, the total height of fluid grout above it after the second lift would be 1.37 m (4.5-feet), resulting in an average fluid pressure of 560 psf, or about 2222.6 kg (4,900 pounds (lbs)) when spread over a 9-square foot area.

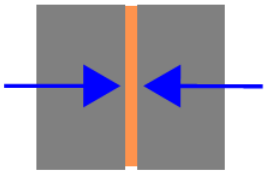
The shank capacity of all ***VoidSpan Port Anchors*** is at least 2267.96 kg (5,000 lb.), however the actual capacity of the installation is dependent upon the capacity of anchor's attachments, and on the strength of each layer of masonry.

In some cases the masonry may have insufficient strength to span the distance between anchors under the grouting fluid pressures. ***VoidSpan Port Anchors*** have threaded inserts and extensions to which temporary dunnage can be attached via threaded extender rods. This dunnage can be of any design and material that can safely span between the anchors. Bending deflection should be limited to not more than 1.58 mm (1/16") under full grout load.

It is assumed that when the third day's lift is placed, the first lift has sufficient strength to support its own weight plus the fluid weight of two 3-foot lifts above it. Nine feet of 120 pcf grout create a presser of 1,080 psf, and a stress of 7.5 psi in the masonry. ***VoidSpan PHLc*** *grout* has a 48-hour strength at ductile yield of about 100 psi.

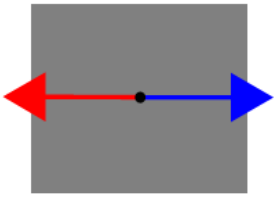
Situations where unrestrained grouting pressures may fail the masonry if contractor does not install dunnage and/or limit lift heights are called "Pressure-Critical", and have more stringent certification requirements for the installer. It is the responsibility of the design professional to determine where and when these situations occur, and to make note of them in the contract documents.

Confine the Composite Mass



The placement of ***VoidSpan Port Anchors*** is critical to providing sufficient confinement to the grouted mass so that it can act as one composite unit. Anchors are to be spaced so that the required loads are resisted within the capacities of the anchors, however in no case should this spacing exceed 36".

Resist Internal or External Loads



VoidSpan Port Anchors with external attachments can also be used to resist permanent, externally applied loads, and are fully compatible when used in

combination with traditional *Cintec* Sock Anchors, from which their design evolved.

VoidSpan Port Anchors can be configured to provide internal tying and tension capacity within friable, randomly voided elements where containment socks are would overly limit the deposition of the grout. Using "slip grouting" techniques, the anchor can create its own linear consolidated zone within the masonry mass through which the needed development of the anchor can be best achieved.

Resists "Rolling Shear" between Layers

True composite action is dependent upon in-plane shear resistance between layers of masonry for shared lateral bending and buckling resistance to occur, in the same way as the veneers of a plywood sheet are dependent upon the glue. This is called "rolling shear".

Unlike typical rod-type fasteners that depend upon dowel action, the ***VoidSpan System*** is a composite-based system that depends upon the critical zone of well-bonded grout (Critical Bond Zone) to create haunch action in which the anchors work in shear friction. Therefore, the shear capacity of the system results from the tension capacity of the anchor applied against the effective frictional coefficient of the bonded void fill.

Available Anchor Types

The following anchor types are available in lengths and capacities to suit your needs:

VS-1, 2 and 12 Series Perforated Shank Anchors for masonry consolidation applications with micro-fine grouts where cleaning and flushing from the anchor is not required. The standard anchors provide up to 2267.96 kg (5,000 lb) confinement tension capacity.

VS-3, 4 and 34 Series Open Shank Anchors for collar joint applications that require cleaning, flushing and use of a fine flowable grout (such as *VoidSpan PHLc Grout*). The standard anchors provide up to 2267.96 kg (5,000 lb) confinement tension and up to 1360.77 kg (3,000 lb) "rolling shear" capacity (even discounting adhesion of the grout).

VS-5, 6 and 56 Series Rod Shank Anchors for masonry consolidation and crack bridging with micro-fine, post-tensioning duct type, or fine flowable grouts where cleaning and flushing from the anchor is not required. The standard anchors provide up to 3401.94 kg (7,500 lb) confinement tension capacity.

STRUCTURAL DESIGN GUIDELINES Available

Guidelines for Structural Design are available on quick turn-around to Registered Professional Structural Engineers (PE, SE) upon verbal, emailed or written request. While those requesting the Design Guidelines take all responsibility for its use, we will be happy to discuss the any questions that you may have and to assist you in the process of design.

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