SureVoid®
Products, Inc.

Points to Address When Specifying, Ordering or Using SureVoid® Products

SureVoid Products, Inc. manufactures void forming products, systems and accessories for use in concrete construction. When properly used these products can be valuable tools for construction on expansive soils and in other difficult conditions. Like all tools, the results achieved depend upon the skill of the user and the proper application.

These conditions deserve consideration when using or specifying void forms during the design process:

- Available soil moisture
- Capillary breaks
- Site climatic conditions
- Potential soil heave
- The under-slab humidity condition
- Structure resistance to uplift stresses
- Imposed loads
- Potential exposure to adverse conditions

The intended purpose of void formers is to provide temporary support for concrete, allowing it to develop sufficient strength to become self-supporting. When the concrete reaches this stage, the underlying forms are to lose the majority of their strength so that any stresses imposed through movement in the underlying soils are mitigated.

Corrugated paper void forms as designed by SureVoid Products, Inc. are intended to achieve this loss of strength through the absorption of moisture. There are two primary sources that should be available to provide this moisture in typical concrete construction: Moisture supplied by concrete during hydration and soil moisture. In most cases these sources are sufficient, if properly anticipated, to provide timely degradation of the form strength.

The actual use of the product, as well as the structure's design, associated work, and product specifications normally fall outside the manufacturer's authority. Therefore, it is important that all who are associated with the project have an understanding of the proper product selection and use based on site-specific conditions. With this in mind, we offer the attached synopsis of options and recommendations relating to the afore mentioned considerations. These suggested guidelines are based on data gathered through our own testing programs and the review of pertinent independent studies, as well as the experience we have developed for over 25 years in designing, supplying and working with our void systems.

PROTECTING CONCRETE FROM SOIL EXPANSION

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Our standard recommendation to designers and users is to utilize the most tender void form with which they are comfortable. As a practical matter this is normally a compromise between ultimate void performance and the contractor's concerns about the product's workability and durability against weather-induced damage. Though the contractor's concerns need to be addressed, they must not severely diminish the performance of the form in creating a void space. Unfortunately, even when proper products are specified and supplied, contractors often make decisions in the field that can compromise the products' performance. Examples of installation errors, the use of capillary breaks, field engineering and waterproofing (bagging and wrapping), are common and will prevent proper performance. An understanding of the intended purpose and importance of the installed void should be required of all personnel involved in the void installation; contractors experienced in void use are preferable. The designer's specifications and manufacturer's recommendations / instructions should be provided to the contractor. Site inspections to insure compliance are encouraged.

Prior to beginning this synopsis it is necessary to discuss associated work, that if poorly performed has the potential to defeat the best void installation. Our primary concern would be the caisson installation. Casting piers with a belled top section severely damages their ability to perform as the anchor they are intended to be. Field personnel generally see piers as vertical supports provided to hold the structure up and fail to recognize the potential damage that results from casting these unintentional pier caps. Any remedial action taken to correct poorly formed piers is generally cosmetic in nature, designed to present an acceptable looking pier at ground level. The damaging belled portion remains concealed under the ground surface. This is inexcusable, since it is easy and cost effective to correctly form these piers using appliances that generally cost less than the surplus concrete that is used in a deformed pier. Expanding soils can, in certain cases, break and heave these piers, resulting in damage to the structure that its design was intended to prevent. The cause of such damage is difficult to pinpoint due to the inaccessibility of the pier after the construction of the structure. Even in cases where the pier does not separate, the loading calculations are rendered moot.

I. Site Soils Information

This information, gathered from the geotechnical investigation, is used primarily by the design team to determine the most appropriate design for the project. This is also primary information required to specify the proper void products, though it is seldom provided to the void supplier or manufacturer. This information will determine the appropriate void thickness, moisture response, special handling requirements or determine if the project is even a proper void application:

A. Maximum potential heave – We recommend a void thickness 1.5 times the maximum expected heave. This provides a space for the void form to collapse into without building pressures due to compression.

B. Soil moisture content – Soil moisture is usually the most abundant source of moisture available for incorporation by the form. Corrugated paper will have higher suction values than soil in most cases, and will readily wet up by drawing moisture from the surrounding soil when available. Soils or substrates that are extremely dry, have very low optimum moisture potential, do not support capillary action, or possess other properties that would deprive the forms from gaining moisture, may dictate other methods of creating the desired void space. They may dictate special handling, such as moisture injection, physical destruction or a combination.

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C. Capillary breaks – Substrates in the area where the void forms are to be used that have naturally occurring capillary breaks (i.e. exposed course gravels at or near the surface) may impede or stop the ability of moisture to migrate to the form. Likewise, the use of gravel or other material as bedding material that creates a break will have the same result. The placement of void forms as intended directly on soil capable of supporting capillary action and supplying moisture creates a surface tension that initiates capillary movement of moisture to the bottom of the form. This moisture is drawn through the permeable cover through osmotic suction and into the form.

To address these concerns, we offer the following options and recommendations:

- If the soil has natural moisture of less than approximately 8%, has capillary breaks or other conditions exist that would indicate that soil moisture will not be available to the form, special handling or other methods of void forming should be considered.

- Soil cannot be frozen at the time the product is used or allowed to freeze after use unless forms have suffered enough moisture exposure to destroy their structural integrity. Severe cold temperatures will slow form deterioration.

- Capillary breaks must not be allowed. The form must rest directly on properly prepared, suitable soil. Void forms have strength to support vertically imposed loads, but cannot bridge uneven surfaces. A properly prepared area must be smoothed to an even plane with no projections that will point load the form.

- On sites with sufficient natural soil moisture, this moisture must be maintained. Our standard recommendation is to have the substrate where the forms are being placed to be at or near optimum moisture. If the site has been open with the soils drying, it may be necessary to return moisture to the soils prior to placing forms. Pre-wetting the soils, which spends some of the potential swell, has been used with success. This would also insure adequate moisture content, and would be worth considering.

- Various coatings and degrees of moisture resistance are offered depending upon the moisture content of the soils, climatic conditions expected at the site, and other factors that may be pertinent.

II. User-Defined Variables Concerning Paper Type

A. In the specification of void forms by SureVoid Products, Inc. there are four paper types offered as standard: (W5C wet-strength can be custom ordered)

1. Plain - No water resistance (SureVoid terminology – extra fast) Use in low moisture, low humidity environments.
   - Regular adhesive
   - No wax or chemical water repellant utilized

   Comments:
   - Extremely susceptible to moisture
   - Once wetted cannot be dried and used

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2. Plain w/water-resistant adhesive - Light resistance (SureVoid terminology - fast) Use in low to average moisture environments.
   - Water resistant adhesive
   - No wax or chemical water repellant used

   Comments:
   - Susceptible to moisture
   - Will hold shape when lightly wetted with no imposed load
   - Can be dried if done immediately

3. WIM – wax impregnated medium - Moderate resistance (SureVoid terminology - medium) Use in average to moist moisture conditions and areas with moderate humidity, or where wax impregnation is specified or recommended.
   - Waterproof(resistant) adhesive through out
   - Corrugated medium of paper is wax impregnated

   Comments:
   - Can be wetted and allowed to dry
   - Holds shape well when wet with no imposed load

4. FWI – Full wax impregnation – Moderate resistance (SureVoid terminology – slow) Use in abundant moisture conditions and in areas of prolonged exposure to high humidity levels, or where full impregnation is specified.
   - Waterproof adhesive through out
   - Liners and medium completely impregnated

   Comments:
   - Highly resistant to initial moisture
   - Can be wetted and dried
   - Holds shape well when wet with no imposed load

B. Moisture resistant compounds in the form of wax or chemical coatings can be applied to one or both sides of all papers.

C. SureVoid typically utilizes a wax curtain coating on the exterior of our forms. We chose this configuration since it offers some resistance to initial moisture penetration and has proven to be permeable enough to allow timely transfer of moisture into the interior of the form. This can be left off if conditions warrant.

D. As a general rule of thumb the paper types above could correlate to the Thornwaite index of arid, dry, moist and wet. However, site specific conditions such as soil moisture, climatic conditions such as humidity, and conditions that would dictate long term exposure to the elements such as complicated or massive reinforcement mats should be considered.

E. Again, with a lot of variables to be considered, the most tender form that would work should be specified.

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III. The Under-slab Humidity Condition

Depending upon the paper type chosen and soil moisture content, the under-slab heat and humidity condition will determine both the short and long term performance of the void form in creating a void space.

We recommend that the voided area beneath concrete structures be sealed (as much as practical) for several reasons. For our purposes, we wish to maintain this moist condition so the forms gain and maintain moisture. It is also necessary to seal this area from any space that may be inhabited to isolate the mold and other conditions that develop as the forms decompose, and to isolate soil molds, organisms and gasses (radon) from the inside of the structure.

In order for the form to utilize the concrete moisture released during hydration it should be contained and allowed to develop an under-slab heat and humidity condition. Design or construction techniques that vent or otherwise allow moisture from the void area to escape, will retard the wetting up of the paper, or will even cause drying of the paper by removing vapor developed from the concrete and wicked from the soil.

Testing has shown that the moisture (about 4 lbs. per cubic foot) released during hydration and the accompanying heat generated, will elevate and maintain the under -concrete temperature for several days (longer when curing blankets or like methods are used) with the accompanying relative humidity levels staying at or near 100%. As the paper forms have an affinity for moisture, this vapor, if contained for three days, allow the forms to gain approximately 20% moisture by weight with an approximate corresponding strength loss of 50-60%. Greater moisture gain and the associated loss of strength will occur with longer exposure. Over time the forms add to this humidity condition by moving soil moisture into the void space. As the moisture in the form builds to 50% by weight, a loss of strength on the order of 90% is typical. Greater moisture build and the associated strength loss occur over time with moisture exposure.

This exposure to moisture deteriorates the forms over time, first by softening the paper causing a loss of structural integrity, and secondly, by destroying the starch based adhesive joining the forms and paper components, and ultimately by contributing to the decomposition of the paper through biological action.

Our recommendations to address this aspect:

The structure should be designed to have an enclosed void space. Most structural slabs have thickened edges or are set on beams and satisfy this need. If a design is utilized that provides openings to the void area through periodic pads or other means, a retainer should be used. The use of retainers will protect the void space from sedimentation or other intrusion into the void area and also maintain the humidity condition.

In large slab areas where several pours are required, the day-lighting of the void area should be minimized between pours by leaving forms in place or providing other temporary means of sealing the exposed areas.

IV. Form strength selection

The second of the two primary properties that determine ultimate void form performance requires matching the forms initial strength to the specific use. This attribute, in collaboration

with matching the forms moisture response to the existing moisture condition, will determine the success of both the initial installation and the degree to which the desired void is created.

In thin veneer structural slabs of less than 16", the live loads imposed during construction often exert much more focused loads than the concrete and reinforcement load that the form is required to support. In conjunction with the lateral loads and differential loading experienced during this type of construction, this requires a form having much greater initial strength than would be required for just the dead load. These thin veneer slabs also generally contain less tensional reinforcement (often a single mat) and require greater compressive strength build in the concrete before they become capable of being self-supporting. It is imperative that the void forms provide support over a longer period (ACI recommends 28 days) to these structures before losing the ability to support this load.

Grade beams, on the other hand, usually have tensional reinforcement in a minimum of two areas: high and low in the structure. They generally become self supporting with less compressive build in the concrete. These structures also are normally contained, eliminating the majority of differential loading, and do not endure the high ratio of point loading compared to the concrete weight the slab encounters.

Thicker structural slabs, having multiple layers of reinforcement, share some characteristics of both other structures. These characteristics are important to consider when determining proper initial form strength. In the last section it was noted that testing and experience had shown that SureVoid forms typically lose 50-60% of their strength with a 20% moisture gain, and an approximately 90% reduction in strength at a 50% moisture gain. These ratios being fairly consistent in the testing suggest that a form with an initial strength of 3000 lbs. PSF will retain 300 lbs. PSF of residual strength for a time at 50% moisture gain, while a form having 800 lbs. of initial strength would retain 80 lbs. under the same conditions.

Both of these forms meet this specification on a 6" structural slab:

> *Void forms shall be biodegradable with moisture resistant faces, capable of supporting the wet concrete and associated construction loads, until the concrete becomes self-supporting.*

To address this issue we offer the following options and recommendations:

SureVoid Products, Inc. offers a wide variety of targeted strength options. By specifying papers of different capabilities and adjusting the frequency of our grid pattern we can achieve over 24 compressive strengths, ranging from 500 – 5000 lbs. PSF.
Though natural variations in paper dictate that these targeted strengths be approximate, we are able to make them close approximations by using single cut structural members. Some other manufacturers introduce multiple variables by folding their structural members.

We recommend that the designer specifies a targeted strength based on the above considerations. Failure to do so allows the purchaser to become the specifier.

Our standard recommendation is to specify a void form having a dry strength 6 – 8 times the concrete and reinforcement weight for a thin veneer slab or other structure requiring longer term shoring. This recommended range should also be considered for structures whose construction techniques typically impose other loading stresses greater than the concrete and reinforcement. We recommend that grade beams or other structures that become self supporting in short order

utilize forms with strength 1.5 – 2 times the weight of the concrete and reinforcement load they will need to initially support. Thicker, heavily reinforced slabs and other like structures will require forms in the middle of this range. Longer spans, adverse conditions, longer term shoring requirements, anticipated early loading of the structure, and other variables may require adjustment to these ratios.

To achieve maximum performance in providing the required void, the designer or user should specify the most tender form with which they are comfortable.

V. Structure Resistance to Uplift Stresses

As discussed in the previous sections, the void forms loss of strength occurs over time as moisture is incorporated into the form. The rate of this wetting up will be affected by factors that determine the availability of moisture to the form. Although these corrugated forms are biodegradable, they will retain a degree of residual strength dependent on their initial strength and moisture content for some time.
Some designs do not allow for any uplift on their structural members. Due to cost consideration or other concerns, reinforcement is often designed to provide tensional resistance only to top applied loads. These designs will then suffer damage with very light uplift stresses imposed.

Our recommendation for this concern:

Design the reinforcement to provide enough tensional resistance to uplift to allow the diminished crush point of the form to be achieved without the structure suffering damage. This can often be achieved with minimal tensional reinforcement of the lower plane of the structure. The amount of required reinforcement should take into consideration the factors that will affect the void's performance as well as the potential soil movement.

When the above factors are considered the potential exists to reach numerous conclusions concerning required void performance. Fortunately we are able to supply numerous configurations of our product to address these needs.

SureVoid Products, Inc. utilizes corrugated paper in our forms for several reasons:

1. The wide range of options available in paper allow us to design numerous strengths.
2. Numerous methods are available to provide varying degrees of moisture resistance.
3. Paper has a great affinity for moisture.
4. These attributes can be combined into useful tools at an economical cost.

SureVoid forms have been used extensively with a high degree of success. We offer these recommendations, instructions and use materials available to contractors in an effort to raise the percentage of successful installations to 100%.

Termed void failures generally fall into 3 categories:

1. Failure to support the initial construction
2. Failure to mitigate the stresses imposed by soil movement
3. Failure to isolate the structure from the substrate

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We perform forensic investigations of all failures of which we are made aware in order to determine cause. Like all disciplines, we continue to evolve by addressing the concerns and problems we encounter.

Though a thorough discussion of all possible conditions that have contributed to the above failures is not possible, the following generalizations (or a variation of such) are usually found to be a root cause.

1. Failure to support the initial construction –
   a. Typically this type of failure will involve forms that were wet or otherwise damaged prior to concrete placement
   b. Using forms of the wrong strength (i.e. placing a 12 foot wall on a form designed for 3 feet of concrete)
   c. Dropping concrete from a height via a pump or crane

2. Failure to mitigate the stresses imposed by soil movement –
   a. Typically forms are found to be dry due to the installation of a capillary break or another condition as discussed previously
   b. Forms with much greater initial strength than required were utilized and retained too much residual strength
   c. Forms are waterproofed to a degree that is incompatible with the use (bagged, wrapped or ordered waterproofed)

3. Failure to isolate the structure from the substrate --
   a. Intrusion of concrete into the intended void space. Usually caused by poor construction techniques, unintentional pier caps by not correctly voiding the transition area from pier to slab, failure to protect the seams between forms, puncturing the form, or failure to provide end caps or other protection at form exposure to liquid concrete
   b. Crushed forms. See section 1 above.

SureVoid Products, Inc. offers a complete product line as well as instructions and recommendations for use, which, if used and followed, will address these as well as all other causes and areas of concern of which we are aware.

We have data and references available from numerous studies and tests, either conducted by or commissioned by SureVoid Products Inc., as well as independent sources that support the conclusions, assumptions, and representations made in this synopsis. These materials are available for review by appropriate parties.

This information has been compiled to help ensure that the void material performs satisfactorily as to its intent. Due to the numerous conditions that exist in the use of our products that are beyond our influence, authority and control, we make no warranty of fitness for a particular purpose. Specifically there is no warranty expressed or implied.