Void Forming Products Used in Concrete Construction - Their Compositions & Characteristics

	Degradable Void Form Systems		Mechanical Void Form Systems (Waterproof)		
	Molded Pulp	**Corrugated Paper**	**Expanded Steel**	**Expanded Polystyrene (EPS) Foam**	**Copolymer Polypropylene (Plastic)**
Description	Type I -Thick-wall molded paper pulp contains recycled paper in a slurry form. A vacuum tooling system is used to mold the shape of the final void product.	Corrugated paper interior cell structure encased in a paper outer cover provides highly customizable strength and dimensional characteristics	Steel sheeting is expanded and configured to produce a void space structure intended to collapse and/or allow pliable soils to migrate through the openings of the mesh	Expanded polystyrene sheets of different densities and are cut into various shapes and thicknesses to achieve the desired characteristics	Flexible, fluted plastic interior supports are slotted and joined together to create a highly customizable cellular structure designed to bend at predetermined pressures
Customization	**Limited** ● Dimensions and shape are limited by the mold ● Performance can be adjusted through the composition of the pulp, shape, and additives in the slurry mix ● Forms must be field-cut to accommodate obstacles and challenging profiles/interfaces	**High** ● Customization through paper types, thicknesses, corrugation methods, number of corrugations and cellular structure variations ● Pre-manufactured, custom shapes to conform to piers and other obstacles are available ● Custom heights, shapes and strength products are achievable	**Moderate** ● Without a cellular-structure design, strengths are partly achieved through spacing of metal pods under a hardboard cover ● Pre-manufactured, custom shapes to conform to piers and other obstacles are available	**Moderate** ● Customization of strength is achieved by changing foam density, leg thickness, and design characteristics ● Nearly any void height is achievable ● Currently premanufactured custom shapes are not available.	**High** ● Customization of strength is achieved by adjusting the plastic density, plastic thickness and the spacing of the cellular structure ● Pre-manufactured, custom shapes to conform to piers and other obstacles are available ● Nearly any void height is achievable
Strength	***600 - 1,700 PSF ***Care must be taken to specify the appropriate strength!**	**Non-Structural - 3,500+ PSF** ● Many strengths are achievable and available due to the cellular-structure design	**100 -986 PSF*** ● *Forms are placed with gaps in between, and overall strength is calculated with the gaps included	**230 + PSF** ● Many strengths are achievable depending on the design	**250 - 3,500+ PSF** ● Many strengths are achievable and available due to the cellular-structure design
Failure Mode	Failure mode by degradation, soil migration and deformation	Failure mode by degradation and deformation	Failure mode by soil migration and deformation	Failure mode by deformation and soil migration	Failure mode by deformation at pre-determined pressures
Moisture Resistance	**Varies** ● Product is designed to absorb moisture and degrade. Moisture resistance is controlled by adding wax or chemical additives into the slurry mix	**Varies** ● Product is designed to absorb moisture and degrade. Moisture resistance is controlled through various methods of coating or impregnating with wax and/or synthetic chemical compounds	**Water Proof** ● While long-term exposure to moisture will cause rusting, forms will remain intact for an extended time period	**Water Proof** ● EPS foam absorbs moisture, but the forms generally remain structurally supportive	**Water Proof** ● The supporting structure of plastic legs is impervious to moisture and will remain supportive. The paper wrap can degrade by design.
Advantages	● Humidity/moisture will degrade the strength ● Forms nest together for shipping and storage cost savings ● Forms are easily cut to conform to obstacles ● Paper materials are less expensive	● The cellular-structure design allows for highly customizable strengths that can be specified by the engineer ● Pre-manufactured custom products ensure intersections with piers and other obstacles or irregular profiles are properly formed ● Product end-caps ensure that concrete does not migrate into the void forms ● Paper materials are less expensive with a long history of use ● Some products can be shipped knockdown and assembled on site ● Delamination of the papers results in total loss of structural integrity	● Waterproof design eliminates moisture concerns ● Premanufactured custom products ensure intersections with piers and other obstacles are properly formed ● Nesting of SOME products achieve shipping and storage cost savings	● Waterproof design eliminates moisture concerns ● EPS foam void material can be designed to incorporate insulative properties ● Premanufactured custom products ensure intersections with piers and other obstacles are properly formed ● Some products can be shipped knockdown and assembled on-site	● Waterproof design eliminates moisture concerns ● Premanufactured custom products ensure intersections with piers and other obstacles are properly formed ● The cellular-structure design allows for highly customizable strengths that can be specified by the engineer ● Product end-caps ensure that concrete does not migrate into the void space
Disadvantages	● Exposure to moisture prior to concrete placement may prematurely degrade the strength ● Current strength options are limited and products may be too strong for many applications ● Intersections with piers and other obstacles are left to "means & methods" in the field resulting in inconsistent results ● Custom-shaped forms and end caps are not currently available ● More waste material created since product must usually be cut to fit ● Excessive strength is assumed to be compensated by migration of soil through openings in the form, a presumption for which there is conflicting evidence ● Will not delaminate - May not lose it's structural integrity	● Exposure to moisture prior to concrete placement may prematurely degrade the strength and structure of the forms ● Forms do not nest	● Field modifications are more complicated than in other systems ● Some designs assume soil migration through openings in the expanded steel mesh. ● Cost is higher than paper-based void forms	● As foam is compressed, its resistive strength increases exponentially, and taller void forms may be required to properly achieve the specified void depth ● Cost is higher than paper-based void forms	● Cost is higher than paper-based void forms ● Forms do not nest