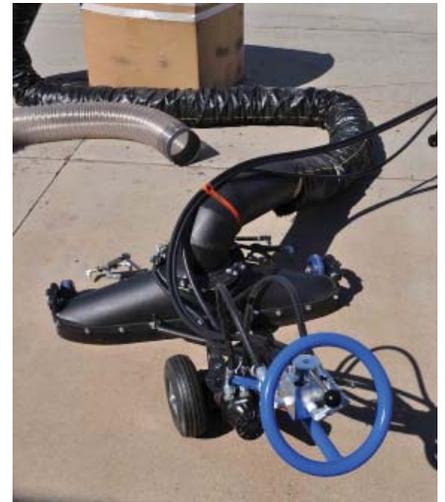


## ***BIRD Update***

Pervious concrete pavement is exposed to various sources of contamination which may clog the void structure and reduce the permeability during the service life of the pavement. We have developed ways to resolve these clogging issues and restore the permeability of pervious pavement if the pavement was originally built with sufficient voids. This cleaning process is also used to prepare the pavement for overlays and other surface repairs.

Truck mounted vacuum equipment can be used to extract contaminants from pervious concrete pavement using a Bunyan Infiltration Restoration Device (bird, for short), to apply the vacuum force to the pavement surface. In order to manage this vacuum force, and move slowly over the surface, certain objectives become apparent.



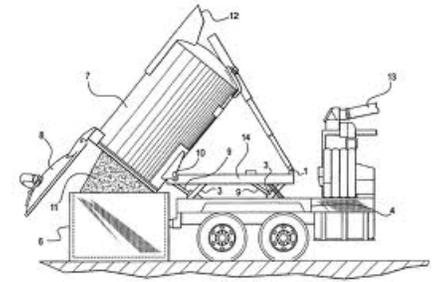
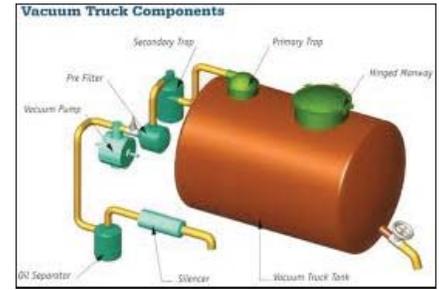
This extraction process for pervious service pulls air through the voids. Performance is at best with a tight seal maintained around the perimeter of the vacuum hood. The hood behaves like the inverse of a hovercraft and represents significant drag, as the hood travels. A drive system propels the device which is tethered to the vacuum source with an extension hose. The height of the hood is set in contact with the surface and adjusted as the rubber belting of the lips wears away. The BIRD is configured on a triangular wheel base and covers a swath that is 42 inches wide.

Some vacuum trucks are equipped with a vacuum hood which typically does not seal tightly and travels too rapidly for pervious restoration. Vacuum sweepers in standard configuration will gather loose material from the surface. This is useful for preventative maintenance in removing foreign matter before it becomes impacted in the pavement voids. This type of vacuum is a regenerative fan, designed to cover a lot of area, quickly.



Vacuum pumps fall into two categories, positive displacement type and fan type. Performance is measured in pressure and volume. The BIRD Vacuum needs at least 3,000 cfm of air volume to operate effectively and the negative pressure starts at around 7 inches of mercury (Hg). Less powerful vacuum equipment is sometimes stated as inches of water to state negative pressure.

Fan type vacuum equipment usually generates pressure around 7 to 12 inches Hg, and high volume (up to 17,000 cfm). These units are popular for sewer cleaning and can provide high pressure wash water for the optional water circuit on the Bird Vacuum. Six nozzles are available and may be positioned to dislodge debris, ahead of the intake. The volume and pressure of the water system supplied by the vacuum trucks varies and it defines the effectiveness of the pressure washer nozzles. The spray of water is directed at the slab surface, near the rubber lips of the intake. Unless adequate pressurized water supply is aboard the vacuum truck, it is best to use a rotary head or a wand on conventional pressure wash equipment. It is important to operate the BIRD Vacuum in close proximity to the washing operation, to gather debris before it flows to other areas.



Positive displacement type equipment typically displaces 3,000 to 6,000 cfm of air at significantly greater pressure. For vacuum units with sufficient horsepower and positive displacement, you can expect up to 27 in.Hg. This type of vacuum is used for excavating and has both hot and cold pressurized water available on board. The extraction process is most effective when powered by this type of equipment. However, it will only restore permeability to a slab that was permeable on the day it was constructed.



We have tested this process on three projects. Two of these are permeability restoration and one is for permeable overlay. None of the slabs were sampled for infiltration upon completion of the original construction. We are not sure exactly how much permeability was restored. But, the results seem to restore the permeability to nearly match its original performance.

The two pilot projects for permeability restoration are in Vancouver, WA. One was exposed to active runoff from adjacent asphalt pavement that carries disintegrated chips of asphalt, along with considerable amounts of sawdust, borne by the wind from a nearby sawmill. The other restoration was tested at a big box in Vancouver. Both showed good performance, but we don't have the original infiltration numbers to compare.

The permeable overlay project is a 6,000 sf site in Chicago. This pervious concrete parking lot was exposed to undue amounts of calcium chloride, used for deicing. The attack was severe, with some places disintegrating the slab down to a depth of 2 inches. Many of the affected areas remained intact at the surface, having been protected by bean oil used for curing during construction. Below the surface materials penetrated by the bean oil, the chloride attack caused extensive damage.

Most of the delaminated areas are easily located with a chain, dragging over the surface. Roto-milling was selected for surface preparation, based on the extent of the damage. Depth of cut was 2.5 inches. The milling process gathered the largest cuttings but left the dust and finer materials laying on the surface for over a month. Rain storms settled the dust into a nasty clog on the milled surface. This was clearly as tough as cleaning gets for our bird vacuum. The mill had chewed the surface down to very rough terrain. This contributed to some difficulty in holding a tight seal at the lips of the intake hood. The pressure washer aboard the vacuum truck was limited. Again, smaller pressure washers were used and gave the best wash with a rotary head. Mr. Brian Lutey is shown using a pressure washer wand, also. Brian is our test pilot for prototypes of the bird vacuum. He graciously agreed to destroy two toad suckers in the course of field trials during development of this equipment.

Time will tell about the performance of the permeable overlay. The milled and cleaned surface was prepared with a nano-silica densifier from Apex Nano. The same densifier was applied to the overlay, after striping. The desired effect is to stop the attack of calcium chloride in the underlayment and create a suitable bond for the overlay. We continue to monitor the white topping on the center lane that covers about 2,000 sf, and the 4,000 sf of permeable overlay at the BTM project, funded by Ozinga in Chicago.



Our other test pilots are at Hildebrand Concrete, in Vancouver, WA. I invited their critical feedback and gave them permission to revise at will. By sundown on the third day, Rick Hildebrand had chopped the hydraulic drive system from the bird and made a self propelled platform with the engine on board. He continues his work as I urged him to focus on two issues. Maneuverability and slow travel are important to get access to edges and tight spots. And, sometimes the process slows to a snail's pace when the hood is well sealed and the extraction is working.

Greg Plumb and the crew at Hildebrand Concrete have discovered a new client base when they showed the ability to "burp the todes" out of pervious concrete pavement. The owners of pervious concrete pavement have a keen interest in doing this process and knowing that this process can be done. Rick discovered the realities of running a positive displacement vacuum truck with enough wood to collapse the intake hose. Then he stuffed it full of rings of pvc pipe, to hold it open. This also helps with the troublesome shortening of the intake hose under extreme vacuum Hg. We appreciate the boldness and creativity that is offered by Rick and Greg. But, mostly I appreciate the participation of George Hildebrand, a legend in the construction of concrete flatwork. His resume shows evidence of his pioneering and his contribution to this industry. We are honored to have him involved and in attendance at the 2011 Bunyan Pervious Roast. Mr. Hildebrand is pictured here with David Frentress, PM2, another legend in the concrete industry.



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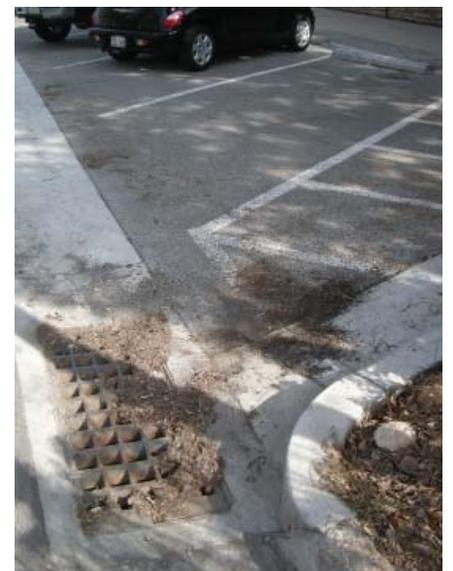
Rather than protecting the aspects of intellectual property related to the bird vacuum, we invite everyone to step up and configure anything that works. The extraction process is long overdue and this issue has caused concern among those who consider owning this pavement. They need definitive answers for restoring and maintaining permeability. We invite everyone to develop and share various equipment and practice that will address the need on two fronts:

#### Scheduled maintenance

The particular design, site conditions, climate, and traffic will generate a certain amount of expected, routine amounts of contaminants. A plan is made, based on the type, frequency and amounts of contamination that will be removed. Make negotiations to eliminate or reduce the sources of contamination. Use dry vacuum equipment to gather contaminants before they enter the voids of the slab. Grass cuttings and leaves will be removed along with the french fries that have not yet been stepped on. The removal of this type of material is vastly easier than removing them after they disintegrate and enter the voids.

#### Extraction

The neglect of scheduled maintenance, flood events or other sources of undue contamination will require an extraction process that is wet. However, avoid the use of pressure washing equipment before vacuuming and rinsing the surface. After the loose materials have been removed, use additional rinse and pressure wash to dislodge contaminants that are promptly removed with a vacuum. Avoid the advancement of pressure nozzles against a wake of silt. These contaminants will sink back into the voids on another part of the slab. Certain amounts of the finest silt will actually pass through the pavement, into the base materials. Continued repetition of pressure washing alone will eventually choke the interconnected voids.



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