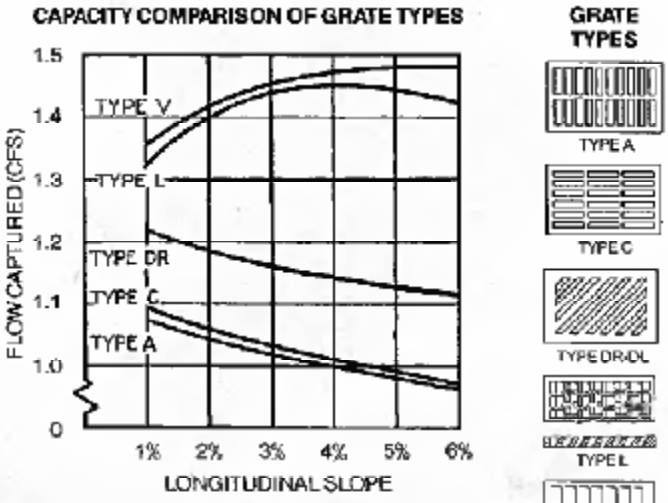
NEENAH FOUNDRY COMPANY

Slotted Vane Drain System for Storm Water Removal

Webster defines potential as "existing in possibility; capable of development in actuality (benefits)." When evaluating existing, or proposed storm water systems, the potential amount of water captured is the design and performance criteria most commonly used in evaluating performances. Potential can also be evaluated when comparing the performance of different styles of inlets used in storm water systems, with the installation having the capability of removing the most water at the highest efficiency being the most desirable.



The above chart shows flume test results using 17" x 20" full size grates in the types detailed top right. A constant transverse or gutter slope of 6% was used to contain more water over the grate. The gutter flow in the channel was set at 2 cfs. Note the improved performance of the Type "L" and "V" Vane Grates.

Figure 1

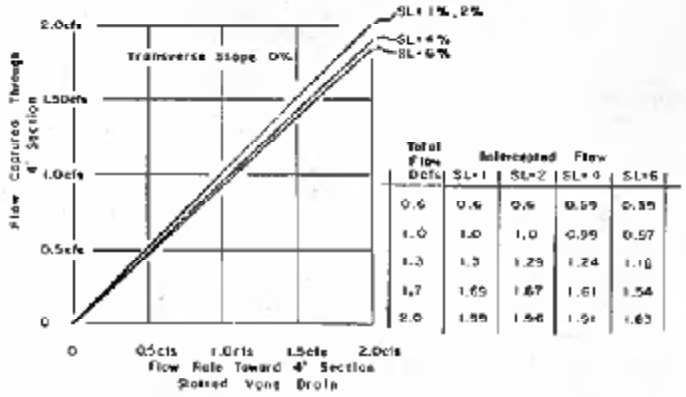
Historically, the more popular inlet grates consisted of the types A, C, and diagonal styles as shown in Figure 1. The efficiency of these grates can be calculated by determining the amount of water contained in the prism directly in front of the grate and comparing that to the amount which is captured. The efficiency is a function of several factors; plugging, transverse and longitudinal slopes, and total amount of flow, so specific efficiencies for installations need to be addressed individually. In general, grates of these styles are less than 100% efficient with the efficiency decreasing as the velocity of the water increases. These grates have one thing in common, that being there are flat top bars crossing the grate. As can be seen in Figure 1, when the longitudinal slope and thus the velocity of the water increases, the performance of the grate drops. This is due to the momentum of the water "jumping" from bar to bar and skipping over the entire inlet, with only a portion of the flow being captured by the individual holes. This can be improved by adding additional inlets end to end, however, the increase in construction and material costs would outweigh other more practical solutions. A grate exists which is hydraulically superior to the conventional style in that it utilizes a vaned shape crossbar to capture the water. The curved shape on the leading edge of the vane supplies a surface for the water to adhere to, with the flat face of the second vane redirecting the flow downwards. Efficiency of the vaned grate is 100% for typical design flows, thus one of the first steps which can be utilized to achieve the desired potential would be to incorporate a vaned configuration for inlet design.

As was pointed out, the efficiency of a grate can be determined, so too can the efficiency of the inlet site be evaluated by calculating the total flow at the inlet and comparing this to the amount captured. Considering typical design flows, site efficiency seldom exceeds 50% to 60% since the spread of flow extends outward into the paved

Cross Section of Vane Grate in Testing Flume Showing Hydraulic Performance at 2 cfs.

area. Unless the inlet is very long and/or the transverse slope steep, the installation will not be able to reach any higher efficiency. "Open throat" inlets, where the lengths can exceed 15 feet, have been utilized to increase the site efficiency and have some advantages in that longer lengths can be 100% efficient and are not very susceptible to plugging. The construction cost of the installation can be high when considering the amount of labor, forming, and materials required to supply such a large underground structure.

An alternative exists which can provide high efficiencies and relatively low construction costs. Neenah Foundry has developed the Slotted Vane Drain which offers the superior



Total Flow Qcfs	Intercepted Flow SL=1	SL=2	SL=4	SL=6
0.6	0.6	0.6	0.59	0.55
1.0	1.0	1.0	0.99	0.97
1.3	1.3	1.29	1.24	1.18
1.7	1.69	1.67	1.61	1.54
2.0	1.99	1.96	1.91	1.83

performance of the vaned configuration as well as the strength, durability, and economy of gray iron. When the Slotted Vane Drain is installed perpendicular to the flow, the unique vaned shape provides a capacity of 0.5 cfs per lineal foot of drain for longitudinal slopes from 0% to 6%. The ideal installation would utilize a vaned grate to capture the flow in the gutter and the Slotted Vane Drain to collect the flow extending into the road way. The Slotted Vane Drain can

also be utilized in the conventional manner by installing it in the gutter parallel to the curb, utilizing the transverse slope of the street to force the water to the openings. The length of the installation required is then a function of the surface slopes and the anticipated amount of flow. One can see the savings which can be realized if the installation is as described earlier, using one Slotted Vane Drain perpendicular to the flow and a vaned grate in the gutter.

Installation is relatively simple, using materials which are commonly found at construction sites. A slot, the width of a standard two-by-four, cut in the top of the PVC pipe allows the Slotted Vane Drain to be positioned atop the pipe and wired securely in place. PVC pipe is utilized as a form only for the concrete encasement, which should completely surround the assembly and extend to the pavement surface. The assembly is adjusted to grade using blocks and lath, then the concrete placed in two lifts to the surface to prevent floatation.

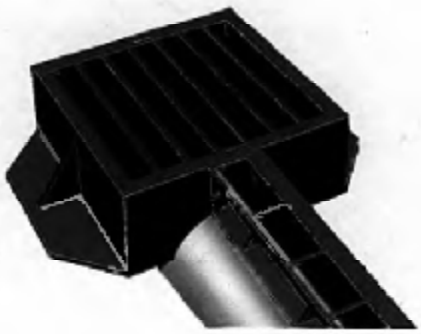
Construction techniques used in Wisconsin, utilizing a concrete saw to cut the top of the pipe and securing the unit prior to placing the concrete.

The advantages of utilizing the Slotted Vane Drain are numerous: 1) Cast gray iron as a material offers durability,

economy and strength resulting in a dimensionally consistent product capable of withstanding heavy duty loading applications. Shear tabs and the overhang of the vane effectively transmit the live load to the concrete with more severe loadings being accommodated by extending rebar from the Slotted Vane Drain into the surrounding concrete. As with all gray iron, the corrosion properties are such that painting is not required, thus the quality of the material can be inspected and determined at the job site without a cosmetic covering to hide potential defects. II) The geometry of the cross section was designed with the narrowest part occurring at the top, thus objects too large to pass through the openings would be noticeable, and would not get lodged below grade to accumulate debris. III) From a designer's standpoint, given the high potential capacity of the Slotted Vane Drain and vaned grate combination, the spacing between inlets can be increased and overall construction costs reduced. The combination offers an additional safety factor in northern climates where snow could be covering the gutter inlets during thaws or spring rains. Snow plows readily expose the Slotted Vane Drain providing a method of capturing the runoff and reducing the possibility of flooding or ponding. The installation can be used at low points to provide additional free open area for inlets to handle area runoff, with the likelihood of plugging reduced since the openings are not concentrated in one area, but rather stretched out over the length of the Slotted Vane Drain.

Installation in Tucson, Arizona employing the Slotted Vane Drain to capture runoff from the street; preventing flooding of the business, which is located at a lower grade than the street.

The combination of the vaned grates and the Slotted Vane Drain provides a method of achieving potentials not realized before when designing storm water systems, thus accomplishing the main objective in storm water management; getting the water off the street as quickly and efficiently as possible. Video tapes depicting the efficiencies of the vaned grates and the Slotted Vane Drain as well as design aids are available. For more information, contact our Product Engineering Department.



Combination of Slotted Vane Drain & vaned grate curb inlet.

Rural Indiana where the Slotted Vane Drain is used to prevent recurring bank erosion. The design required a facility with high hydraulic capacity and low maintenance. The Slotted Vane Drain was installed parallel to the curb as well as perpendicular to the grate at the base of the hill to capture all the flow.

Bartlesville, Oklahoma required an urban installation which could collect the flow in two directions, allowing pedestrians greater access to the crosswalks. The installation also provides an additional safety factor should a newspaper or debris cover part of the openings.

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