HELICAL "N" VALUES FOR CORRUGATED METAL PIPES

Helical (spiral wound) corrugated metal pipes low "n" value data are often misleading to the design engineer. While it may be true that helical corrugated metal pipes may produce a spiraling effect for special full flow conditions, thus resulting in lower "n" values, such conditions are not representative of typical storm drain installations.

HISTORY

Helical corrugated metal pipe with the standard 2-2/3" x 1/2" corrugation pattern differs from pipe made with annular corrugations in several ways. Helical CMP is fabricated from a continuous roll of galvanized metal into a spirally wound pipe with the corrugations set at a prescribed angle to the axis of the pipe. As the pipe is being fabricated, a lock seam or a continuously welded seam is made.

The angle of corrugations, called the Helix angle, varies with the diameter. As the finished pipe comes off the fabricating machine, the pipe is cut into prescribed lengths, usually 13 feet. In some cases, the ends are recorrugated into annular corrugations so that connecting bands will hold the pipe together when installed.

LABORATORY HYDRAULIC TESTING

Producers of helical corrugated metal pipes claim to have an improved roughness coefficient, or Manning's "n" value (see Chart 1), which is only partially correct.

Laboratory tests were conducted to determine the effects of the spiral motion of water traveling through the pipe[1]. A continuous line of pipes for each diameter was constructed in the laboratory and tested under a variety of conditions, such as: velocity, helix angle, water temperature, etc. While these tests proved that water will rotate in a helical CMP, similar to a bullet fired from a rifle, it does not take into consideration a number of limiting factors, such as: must be full flow conditions; no disruption of flow due to man- holes, bends, junction structures; no debris or bedload; circular shape; no paved inverts; and no recorrugated ends.

MANNING'S "n" VALUE CORRECTION FOR TYPICAL INSTALLATIONS

Since manholes are placed throughout a typical storm drain system, usually about 350 to 500 feet apart, whatever spiral effect that may have developed will be disrupted when entering each manhole. The spiral effect will cease, water will rise in the manhole, and then, as the water proceeds downstream, the spiral effect must be organized again. It usually takes twenty diameters or more to develop the spiral effect. Therefore, since only a portion of a storm drain system can operate under the lower "n" value condition, the system must be designed for the disrupted flow condition, or the traditional values established for annular corrugations. Additionally, each end of a section of pipe is re- corrugated to form annular corrugations for joint makeup using external bands. With recorrugated ends approximately every 13 feet throughout the pipeline, this will have a disruptive effect to the formation of a spiral flow.

Chart 1

Summary of Laboratory Friction Measurements for
12", 18" and 24" Helical CMP for Full Flow Conditions

	-----------------Laboratory Testing-------------	
Diameter	Manning's Velocity "n" Value	Velocity in fps
12"	0.0122*	14.9
12"	0.0192*	0.5
18"	0.0152*	14.0
18"	0.0168*	0.9
24"	0.0166*	12.1
24"	0.0221*	0.6

*** Note: Recommended Manning's "n" value of 0.024 be used rather than the helical values shown above.**

CONCLUSION

In order for the reduced "n" values to be applicable, <u>all</u> of the following factors must be met:

1. Full flow conditions.
2. Clear water flow (no debris or bedloads).
3. Circular shape after installation.
4. No manholes, junction structures or bends, must be straight sections.
5. Non-paved invert.
6. Pipe ends are not re-corrugated.

Storm drain systems are constructed with manholes or junction structures and do not reflect the conditions used in the laboratory. Also, storm drains do not always operate under full flow conditions, therefore, **it is recommended an "n" value of 0.024 for corrugated metal pipes be used.**

(1) St. Anthony Falls Testing Laboratory, University of Minnesota