CONCRETE SIDEWALKS & DRIVEWAYS
City of Bedford

It is not unusual to drive up and down Bedford streets and see contractors replacing patios, driveways or sidewalks. When the purchase of one of these items is required, most residents merely call several contractors and then compare pricing. The low bidder then comes and installs the new work according to their bid proposal. There is nothing wrong with this generally accepted system, but as in the purchase of any expensive item, the homeowner accepts a certain amount of responsibility for knowing what has been purchased and whether the prescribed materials and methods of installation are the correct ones for the job.

Much research has been done on concrete materials over the years, and while it can be a very complicated issue, it does not have to be for the homeowner. Here are a few pointers that everyone can understand about concrete and the way it should be installed.

First, concrete results from the mixing of various materials in set quantities, much like baking a cake. The amount and quality of the ingredients decides to a large part the quality of the finished product. Water, sand and gravel, and cement are the main ingredients of poured concrete. Each of these ingredients is equally important to the mix, and the quantities are crucial for the durability of the finished drive or sidewalk. The amount of cement in the mix generally determines how strong the concrete slab will be. A usual mix for walks and drives will contain 6 "sacks" of concrete per cubic yard of concrete, and will yield a strength of approximately 3000 pounds per square inch.

When concrete is delivered, it has a measured amount of water in it that makes up the mix. Adding more water at this time damages the concrete in direct proportion to the amount added. Adding one gallon of water per cubic yard decreases the strength of the concrete by nearly 10%. It also increases the shrinkage that causes cracks to appear, and it reduces the freeze-thaw resistance by 20%. Water should never be added to the mix at the jobsite.

Another little-known ingredient of concrete used outside where it will be exposed to road salt and to freezing temperatures is a liquid chemical called air-entrainment. This chemical simply causes very tiny (microscopic) air bubbles to form throughout the concrete slab. Air-entrained concrete is much more resistant to the freeze-thaw cycles of the Bedford area, and is also much more resistant to damage from deicing salts. An air content of about 6% is usually specified. Air entrainment is not used for interior concrete that is not exposed to freezing, and it has almost no effect on the strength of the product itself.

The "curing" of the concrete slab is potentially the most important concept to understand. Concrete does not get hard by drying - like paint does, but it gets hard by curing. Concrete that is not properly cured will develop **less than half of the strength** of that which is properly cured. The lack of adequate curing time will also vastly increase shrinking and cracking and greatly diminish the resistance to deicing salts. Curing is accomplished through a chemical process known as hydration. Concrete will cure in the absence of air, such as under water. Hydration begins as soon as the water is added to the cement/gravel mixture. It usually takes about two hours to get to the point when the hydration actually causes the mixture to harden, so that is usually considered the maximum time for the concrete to be delivered, placed and finished. Hydration will continue until no moisture is left in the concrete – potentially for several years.

Most concrete will cure, however, to about 50% of its total strength in about 3 days, and to about 85% of its total strength within 28 days – provided that it is cured properly. In order for concrete to cure adequately, it must be kept very moist. The hot sun is the biggest enemy of proper curing, while a brisk, warm breeze is also very damaging. There are many accepted ways to keep the concrete moist for curing. Once the surface is hard enough to walk on, a soaker hose may be used to keep the surface wet. Burlap or canvas may also be laid on the surface and kept wet for several days. There are curing compounds that when sprayed on the new concrete will form a thin film on the surface, which seals in the moisture for a time. Any of these or other methods of keeping the surface wet during the curing time will do the job. Special means must be used, however, to protect the curing cycle when the concrete is poured in extremely hot or extremely cold weather, and these conditions should be avoided.

Crack control should be utilized to yield the best possible final product. Most concrete will crack to some extent regardless of the precautions taken to prevent cracking. Joints may be placed in the slab to cause the concrete to crack in predetermined locations. Saw cuts may also be installed in the final product to control cracking – but it is important to note that the cracking will occur while the initial curing is taking place. Saw cutting must take place within the first 24 hours that the concrete is placed, or the advantages of the cuts may be lost. Saw cuts in most slabs do not exceed sections of about 10 feet by 10 feet and depths of 1 ½ to 2 inches. Serious cracks may also be prevented by not allowing rain water (which eventually freezes and lifts the slab) to gather under the slab. We accomplish this by placing up to 4 inches of gravel base under the concrete slab so that water will drain away before it can freeze. Even the gravel base must be placed on a well-graded, flat sub-surface to promote the drainage of moisture away from the concrete slab.

Last, it should be noted that smoothing the concrete with a metal trowel is largely not necessary for exterior slabs. Concrete is leveled for the most part by using long, straight tools called screeds, which level the mix across a wide area of slab. A metal or wood tool is then passed over the fresh surface several times to fill in any voids or holes caused by the mix settling into the forms and to seal the surface and depress any gravel aggregate which may be protruding from the fresh mix. Finally, a push broom is commonly used to give the surface a uniform but not perfectly smooth finished surface. Excessive troweling will cause the very top layer of concrete to be weak and susceptible to pitting.

Your city building inspectors will be happy to explain these and other precautions that can be taken to insure a quality concrete installation.