Dream Pools and Spas in Cold Climates: Made a Reality with Shotcrete

by Dennis Burns and Marc Ferland

We see them in Hollywood movies, in luxury hotels and resorts, in state-of-the-art water parks, and now in residential backyards. Exotic, fantasy pools and spas harmonized within water gardens, waterfalls, and statues are now gaining in popularity. Whether it is for entertainment, exercise, the occasional dip, or simply pure family fun, pools and spas are definitely the way to go.

Unfortunately, these dream oasises are most often seen in hot weather climates for obvious reasons. But shotcrete has helped change this trend and has given northerners a chance to own and enjoy wonderful pools and spas.

Fig. 1: A residential pool with waterfall and slide

This article describes several projects undertaken by a shotcrete contractor based in Quebec, Canada, and reveals how they deal with the climate constraints with the help of shotcrete to deliver astonishing works of art.

Shotcrete Advantages

Shotcrete, a pneumatically applied concrete, has several advantages for building pools and spas. Owners and clients typically ask for natural-looking finishes with man-made ponds and waterfalls. Shotcrete is ideal for this type of job. Along with proper equipment, training, and artistic talent, shotcrete can take on various shapes, sizes, and textures. These facilities are not only beautiful, but very durable and practically maintenance free.

Since shotcrete requires little or no form work, it allows for complete freedom of pool size and shape. This same ability also gives the freedom to use the existing landscape, minimizing costly excavation and blending the facility perfectly into its environment. Shotcreting also works well on several popular design elements such as vanishing edges and family-friendly beach entries. A shotcrete structure is versatile, sturdy, and readily adaptable from the very smallest to the largest application.

An interesting advantage to these new natural-looking features is that the structure will actually improve aesthetically over time as the shotcrete structures age.

Shotcrete's versatility, lower cost, and durability make it easy to fit curves, shape waterfalls, fireplaces, barbeques, and more, leaving only your imagination and/or budget to limit the projects.

Climate Constraints

Quebec's harsh, cold climate poses several constraints for the construction, durability, and operation of these facilities. Due to freezing-and-thawing conditions, the shotcrete structures must be constructed in accordance with requirements for freezing-and-thawing resistance.

The reinforcement scheme must also comply with specific codes that vary from one location to the next. The reinforcement is mandatory, especially in these conditions, to counter any differential ground movement, restrain any possible crack opening, control material dilation due to temperature gradients, and to ensure structural integrity. Due to the artistic nature of the projects, reinforcing bar must often be bent and curved to fit the desired design. This can often pose problems as large-diameter reinforcing bar is difficult to shape and bend. It is also very important not to congest the shape with reinforcing bar so as to leave very little space for the shotcrete to encapsulate the reinforcement.

When working on big projects that extend into the cold weather months, the crews must build shelters to shoot in acceptable conditions.

Spas constructed with shotcrete are not limited in size. Year-round operation in cold climates, however, requires a significant amount of energy, particularly for larger spas. For example, a 30-place spa in Quebec, Canada, that is operated year-round may require $25,000 per year for heating alone.

Contractor

A shotcrete contractor in Quebec, Canada, has gained extensive experience over the years and has proven that pools and spas can be successfully built and operated in cold climate regions. Contractor Béton Projeté M.A.H. developed a systematic work method to deliver top quality projects to their clients.

To produce consistent quality shotcrete, the M.A.H. nozzlemen are ACI/ASA trained and certified. They have extensive experience in practically all shotcrete related projects including architectural shotcrete using both the wet- and dry-mix processes.

The projects all start with a client's vision of his dream oasis. He transfers this idea to the estimator who roughly sketches the idea on paper. He then turns this idea into a scaled-down model made from clay. Figure 5 is a model of a project undertaken in the Quebec region. Figure 4 and 7 are pictures of the actual projects underway.

M.A.H. has devised this intermediate step over the years to clarify the client's vision of the project for the project team. The scale model helps the client visualize and modify his ideas if need be. As a result, the estimator can thereafter better communicate the client's vision to his crews.

His team consists of the steel artist in charge of forming, welding, and placing the reinforcement; the nozzleman who shotcretes; the sculpture artists; and the paint artist. The use of the scale model has proven to be an invaluable tool in meeting client expectations.

Fig. 2: A shotcreted fireplace

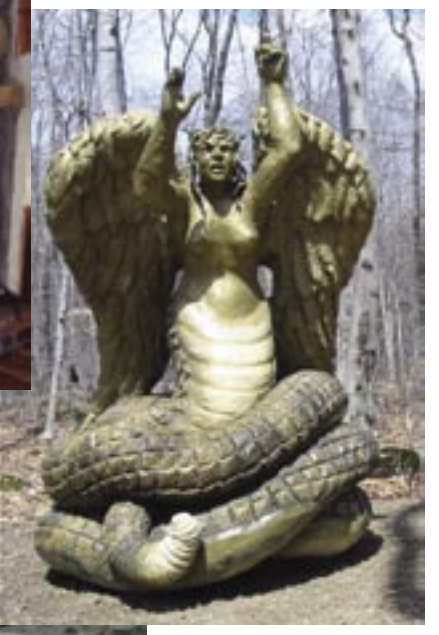

Fig. 3: Detailed statue

Fig. 4: A 30-place spa with waterfall

Fig. 5: Scale model of a water garden

Construction

Once the scale model is completed, the crew can begin the project. They start by excavating the ground to reveal the general shapes of the various parts. They then call upon their steel artist who shapes, bends, welds, and places the steel reinforcement as required. The reinforcement scheme usually has 3 to 4 in. (75 to 100 mm) of shotcrete cover.

Fig. 6: Rebar scheme inside shop

M.A.H. often prefers to assemble the reinforcement scheme inside their shop for better quality control. Figure 6 is a picture of the reinforcement scheme for the spa presented in the two first pictures of this article. Once the steel mesh is ready, it is loaded onto a truck and deposited in its final location on site.

After placing the reinforcing bar, the nozzleman and his crew shotcrete to the desired thickness. The wet-mix shotcrete mixer/pump used is a P13 Putzmeister equipped with a continuous feed water metering system, a paddle mixer, and a hydraulically-powered unloading material system.

The nozzleman has a variety of spray nozzles to choose from depending on the type of application. For precise artistic jobs, they have a specially designed spray nozzle assembly equipped with a 0.5 in. (13 mm) nozzle opening to ensure accurate, low volume shotcrete placement.

The specially formulated shotcrete mixture has an excellent pumpability, which is critical when pumping with small-diameter hoses. The mixture is also sticky, allowing good build up, low rebound, and excellent workability, making it easy to trowel finish. It also has an extended working time prior to setting to allow artists to carve and shape the different details, usually up to 8 hours.

Once the shotcrete is in place, the carving begins to create the desired appearance. If greater thickness is needed, as in the case of statue ears and eyes, successive passes are done.

The final step consists of applying the paint to give it its final look. Several types of paints may be used.

When pools or spas are to be operational year round, the construction involves a few extra steps. In cold regions and where snow is abundant, the walkways that lead to the pools or spas may also include radiant flooring. To melt the snow and keep your feet warm, glycol filled tubes are placed prior to placing or shotcreting the walkway.

Crews first shoot urethane in the excavated hole to act as a barrier. They then add 6 in. (150 mm) of rocks to drain any water, followed by 2 in. (50 mm) of polystyrene to insulate, and then the reinforcing bar. They are then ready to shotcrete the pool or spa.

Fig. 7: Water garden

Fig. 8: Waterfall shot onto rock is natural looking and hardly distinguishable from natural rock

Conclusion

The success of these jobs can be attributed to three important factors: a proven construction method, careful planning of the project, and the individual effort put in by skilled team members.

The shotcrete method of constructing pools and spas offers significant advantages in design, constructability, and cost over other methods.

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Marc Ferland *is President of Béton Projeté M.A.H., a shotcrete contractor in Quebec, Canada. The company has over 20 years of experience in the shotcrete business and specializes in artificial rock, pools, spas, water parks, water gardens, statues, zoo exhibits, parking lots, repairs of all kinds, and much more.*