



Figure 1 (above). 1920's Gunning Crew.

By George D. Yoggy

**A**t the beginning of the 20th century, significant pieces in the foundation of America's Industrial Revolution were established in the Lehigh Valley of Eastern Pennsylvania. Iron and steel, important products to the early development of our continent, were produced in Bethlehem, Pa., and the first production of portland cement in North America took place in Coplay, Pa. The Lehigh Portland Cement Company was founded in Allentown in 1897, and cement production is still an important industry in the area. Several support businesses and professions, as well as Lehigh University, resided in the valley to provide engineering, design, testing, and manufacturing services for the production of cement and steel. Also early in the century, in 1904, the American Concrete Institute (ACI) was established, and the Portland Cement Association was formed in 1916.

The development of both the cement gun and the Guniting process in Allentown was not coincidental. In the community, there was abundant understanding of and interest in cement and concrete, concrete construction methods, and design and fabrication for a commercially viable machine to apply materials, as invented by Carl E. Akely. The first machine was introduced at the Cement Show, in New York, in December 1910.

The term Guniting was coined in 1912. The unique idea of applying mortar onto a surface at high velocity was an immediate success. Early projects included encasement of structural steel support elements in New York's Grand Central Station to strengthen and protect them against fire and corrosion. The density, bond characteristics, and compatibility with structural steel elements, as well as the longevity of protection, created a design and construction demand for this type of application throughout the rail and bridge industries. Water transport and storage facilities became common Guniting construction applications because of the reduced forming requirements and the superior properties of concrete placed by the pneumatic spray method.

By 1915, The Cement Gun Company had grown to become a large contracting organization, and their numerous application projects included construction and repair of buildings, bridges, reservoirs, dams, tunnels for sewer, rail, and water and repair of furnace linings in steel production and other high temperature process facilities.

The early 1920s saw widespread use of this sprayed concrete application process, and eventually, growth in sales of the machine that included instructions for its use as well as permission to use the name Guniting by the franchisee. Guniting construction projects spread throughout North America, and some firms were formed from crews of the original company after completion of a project in a given area. Other contracting companies were formed to satisfy a demand in a given market. Patent documents and copyrights were clear on the mix design and application requirements, and only material placed by a genuine "cement gun" could be called "Guniting". The process crossed the Atlantic and a UK Cement Gun Company was founded. Successors to many of the early franchises still exist (in name) today, and the UK sprayed concrete (guniting) industry is alive and well, all born from the original Allentown activity.



Figure 2. Nozzlemaster applying "Guniting" for a water storage facility in Pittsburgh, 1919.



*Figure 3. Restored, reinforced “Gunite” flue at American Smelting and Refining Co., Helena, Montana, 1924.*

Bryan C. Collier, the first president and one of the founders of the Cement Gun Company, exhibited a strong interest in producing and publishing test data to confirm the quality and versatility of “Gunite” in support of the designers and users of the process. Early tests to establish the compressive strength, bond, and density, believed to be greater than that of cast concrete because of the compaction capability, were carried out at Lehigh University by Professor M. O. Fuller. Data showed significant qualities in both vertical and horizontal shot specimens. Subsequent tests were carried out at the University of California that confirmed the superior properties of concrete placed by the pneumatic method. The density and “water tightness” made “Gunite” valuable for construction of water storage tanks and facilities, as reported in the proceedings of ASCE, August 1917. Further data followed from studies at Toronto University, the Bureau of Standards, the Department of the Navy, and many others, all before 1939.

Today, our industry is often faced with challenges by the engineering community to provide data that support the quality and properties of pneumatically applied mortar and concrete. There is a generous history and much information available if one researches the literature from the universities mentioned, as well as early publications of Engineering News Record, ASCE Proceedings, and



*Figure 4. Test of “Gunite” slabs made under supervision of Prof. M. O. Fuller, Lehigh University. [The tests were started in 1920 and ran through 1934. The 8' 0" (2.4 m) span, 3-1/4" (82.6 mm) thick, deflected 2" (50 mm) by 1922 and stressed the reinforcing to 36,000 lb (160 kN) at completion. No further deflection occurred after the 3rd year.]*

project case studies beginning in 1912 and continuing into the 1930s. What we call “Shotcrete” today is perhaps the most unique and technologically advanced concrete construction method available to us. I’m not sure where the information gap started. We will endeavor to identify the period of change as this series on the history of shotcrete continues.



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