

The Erie Canal – America's First Concrete Classroom

by Luke M. Snell and Billie G. Snell

As the 19th Century dawned, the United States was still basically confined to the Atlantic coast. Although the new nation greatly enlarged its boundaries by the Louisiana Purchase of 1803, the Appalachian Mountains and the lack of an interior interconnected waterway made it difficult to penetrate the vast forested lands to the west of the 13 original colonies.

Albany, New York, was still a frontier town. The overland movement of goods was cost prohibitive. An eight-horse wagon took 15 to 45 days at \$100 per ton (0.9 tonne) for the journey from Buffalo to Albany.¹ As a result of these circumstances, New York State officials saw an opportunity for the future development of the area and also to provide a major western route for the United States. This, coupled with salt deposits at Syracuse and the need to transport that salt to the east coast, stimulated interest in a canal system across upper New York.

Not everyone was interested in a canal system in New York. When President Jefferson was asked to fund construction of the canal, he had just signed a bill to start work on the National Road west from Baltimore. Jefferson's reply to the request: "It is a splendid project and may be executed a century hence...here is a canal of a few miles projected by General Washington (the Potomac Canal) which has languished for many years because of a small sum of \$200,000...cannot be obtained...think of making a canal 350 miles long through a wilderness! It is a little short of madness to think about it."²

As a result of Jefferson's action, New York state legislators were no longer

enthused with the construction of the canal since the state would now have to totally finance it. At the close of the war with England (War of 1812), a petition explaining the benefits of a canal system circulated throughout the state, especially through those counties in which the canal would pass. The legislation received appeals from more than 100,000 people to build the canal. Due to public pressure, the State of New York finally authorized \$20,000 for a detailed survey, and construction of the canal system began July 4, 1817.

Although the people of New York were willing, several challenges became evident. The proposed canal was over twice as long as any previously constructed and, at this time, the United States had few engineers.³ Several debates on whether to hire foreign engineers or "do it ourselves" were conducted in the New York Assembly. Many saw this as an opportunity to prove that Americans could handle their own destiny. The final decision was to design and build the canal system with United States personnel; thus, the Erie Canal would be the laboratory for America's "first school of engineering."

HISTORY OF CONCRETE

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In 1816, a young self-trained engineer, Canvass White, was hired as an assistant to the surveyor. Although his formal training consisted of some basic mathematics, science, and surveying, White's ability caught the eyes of the chief engineer, Benjamin Wright, and the governor, DeWitt Clinton. Since knowledge of canal construction was so limited, Clinton requested that White go to England and study the existing canals, locks, and buy improved surveying equipment. White journeyed to England, walked the canal system and sketched in great detail its construction.^{3,4,5} Armed with these details and with the very latest surveying equipment, White stepped into a major technical challenge.

The canal was designed to go from Buffalo (another small settlement) to the Hudson River at Albany. To build this 363 mile (584 km) waterway, 83 locks were required. The ideal way to build the locks was to use stone and cement. Mortar made from this cement would become harder, relatively impermeable, and would be ideal for use on the Erie Canal system. Basically, the limestone rock used to make the cement must contain the right amounts of natural ingredients so that the natural hydraulic cement is a product rather than the lime. This cement was available only in Europe and had to be imported at great cost. Lime was manufactured in the United States but was not as durable as the natural hydraulic cements. Earlier, consideration had been given to building the locks out of wood due to the abundance of lumber but this idea was dropped due to the short service life of such material.⁴

The concept finally agreed upon was to build the locks out of stone and lime

Excerpts from "Directions for Using White's Patent Hydraulic Cement":⁶

"To every bushel of the powdered cement add one bushel of sand, mix them together and pass them through a sieve, then add a sufficient quantity of water to make it (by well mixing and working) about the consistency of a soft putty. It is then fit to use but should not be kept more than six or eight hours and should be thoroughly worked just before it is used."



Canal engineer White

"The valuable properties of this cement depend in a great measure on the mode of preparing it for use. The mixing should therefore be conducted with care in order to form a perfect union of the powdered cement, sand and water. This can be best accomplished by the use of the New England corn hoe on a board floor or by beating with a hand stamper; not much labour is required if properly applied. Mechanics can judge when the mixture is perfect by the appearance of the mortar, which, when properly prepared, very much resembles putty."

"The sand should be neither coarse nor fine but of a middling quality or about the size of the common pop(p)y seed. If the sand is too coarse the mortar will be short or brittle...If the sand is too fine the cement will shrink and crack after it has been used."

"This cement can be used in any situation and for any purpose to which any other mortar or hydraulic cement can be applied. It does not become perfectly hard within one or two months."

mortar with the outer edges of the mortar joints made with the imported natural hydraulic cements. This compromise used as much of the local resources as possible and would still provide a fairly durable lock system.

While traveling in England, White had witnessed the manufacture of the natural hydraulic cements. In 1818, he experimented with several local limestone sources that were near the Erie Canal. He found one deposit near Chittenango, southeast of Syracuse, that would form a natural hydraulic cement when correctly processed. (This process involved heating the limestone and reducing the end product to a powder.) This cement was used in canal construction as early as 1818 and in all face work of locks and arches. Some of this work still remains in place.

The plant at Chittenango produced many thousands of bushels of cement annually until at least 1840.⁵ Although White patented his cement, he never trusted his patent. He wrote that the production of cement must be "a good and cheap article...As no reliance can be placed on a patent, our only protection will be in honesty and punctuality."⁶ To insure that his cement was

correctly used an instructional brochure was prepared.⁷

As the first concrete engineer of the United States, White was able to incorporate his natural hydraulic cement into several other American canal systems. The solution to the challenges presented by the Erie Canal enabled the country to expand at less expense, to develop young and bright engineers, and to manufacture America's own natural hydraulic cement. White's patented cement was now available for the young country to further American enterprise and to continue the development of the new nation.

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Luke M. Snell is professor and chair of construction, Southern Illinois University, Edwardsville, Ill., and is the chairman of ACI's Educational Activities Committee. A current and former member of several technical committees, he has been on the faculty at Edwardsville for 16 years. A Fellow of the Institute, he is also a former president of the Missouri chapter.



Billie G. Snell is an educator consultant and teacher as well as president and owner of Snell Educational Enterprises, Edwardsville, Ill., which develops science kits for children.