

## international

### HONORS

## ASCE Designates Incan Sites As Engineering Landmarks 11/6/2006

By C.J. Schexnayder

More than five hundred years ago, the supreme ruler of the Inca empire, Pachacuti, ordered the construction of a royal resort in the remote mountain jungle of his empire. This edict led to the creation of one of the true engineering masterpieces of the ancient Americas – Machu Picchu.

Each year, hundreds of thousand of visitors tread the streets of this mysterious "lost city" of the Incas. The cultural, archeological and – for many – spiritual significance of the site can be overwhelming. So much so, the importance of the engineering feat is often overlooked.

"The true miracle of Machu Picchu is how it has held up," said Kenneth R. Wright, a member of the American Society of Civil Engineers. "Why didn't it slide down the mountainside in the last 500 years?"

Wright, president of Denver-based Wright Water Engineers, has been studying Machu Picchu in conjunction with noted Peruvian engineers for more than a decade and has written several articles on the engineering of the site.

He championed the naming of Machu Picchu and another important Inca site, Tipon, to ASCE's **Historic Civil Engineering Landmark Program**. The society granted both sites landmark status in September.

The Historic Landmark program was begun in 1966 in order to "recognize and encourage preservation of landmarks, as well as promote historical awareness of civil engineering both professionally and to the general public."

To be recognized, a project must be nominated by an ASCE section and then evaluated by a review committee. A site must be more than 50 years old, it must be structurally or technically unique and it must be of historic civil engineering significance.

The committee determined that both Machu Picchu and Tipon displayed complex infrastructure that illustrates the advanced civil, hydraulic, and geotechnical engineering capabilities of the Inca people.

"Recognition like this is important to promote the importance of Machu Picchu and other such sites in Peru," said Jorge Puente, Consul General of Peru in Atlanta who accepted the award on behalf of his country. "These are not places just for the normal tourist to visit, we want to encourage more technical study of these places."

Tipon, although less well known, boasts some of the most advanced hydraulic and geotechnical engineering in the pre-Spanish Americas. Exceeding the efforts at Machu Picchu in many respects, Wright explained.

"Tipon is a completely different ballgame than Machu Picchu," he said. "It boasts the best terraced stonework in all of Peru and it has a revolutionary water system that makes conjunctive use of groundwater and surface water."

The Inca Empire at its peak extended from Colombia in the north to parts of Argentina and Chile. It included a population of more than 12 million people. A 10,000-mile network of roads across the Andean mountain range unified the empire.

Archeologists believe Machu Picchu was built in the middle of the 15th century at the peak of Incan prominence. The actual methods of construction used by indigenous engineers remains a topic of debate.

The Incans abandoned Machu Picchu by the middle of the 1500s after the Spanish defeated them and took control of South America. Wright's research shows that the site was still under construction at the time.



High in the Andes, Incans built cities with water and sewer systems.

### Slideshow



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In 1911, Yale University Professor Hiram Bingham famously re-discovered the site and it has captured the imagination ever since. Almost 700,000 people visited the site in 2005, making it one of the most popular tourist destinations in the western hemisphere.

Machu Picchu covers about 25 acres perched precariously on a ridge more than 1,500 feet above a bend in the Urubamba River in Southern Peru. This is the high jungle and the location receives almost 80 inches of rain annually.

Engineer Wright is impressed by the Incan skills at site preparation. For him, Machu Picchu represents, "a masterpiece of site selection, city planning and design." Moreover, all of this was accomplished by a culture that "did not have the advantage of the wheel or a written language."

As much as 60 percent of the building effort went to site preparation, drainage and foundations, he says.

The Incan engineers used more than 700 terraced walls to ensure slope stability. Many of these were also used for agriculture. Wright notes that the city – which had a population of more than 1,000 when the royal Inca was in residence – was completely self-sufficient.

Water from a spring was brought to the site via a stone-lined canal and then flowed through a complex system of drains and fountains. Water quality was ensured by the use of separate systems for supply and drainage.

"When people think of Machu Picchu they think of this ancient tourist place to visit," Wright said. "This designation shows that American engineers recognize it has special features in terms of its construction that need to be studied and understood."

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