The Thousand Year Temple
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Innovation

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Hawaiian Hindu Temple pioneers innovative concrete strategies for long-lasting foundation

While the world scrambles to prevent our high-tech computers from bringing civilization as we know it to a screeching halt at the dawn of the second millennium, the Iraivan Hindu Temple in Hawaii is progressing toward the ambitious goal of lasting right through 3000ce. No "Y2K" or even "Y3K" computer bug will ever hamper this low-tech combination of hand-carved granite and monolithic concrete foundation. The temple is the inspiration of Satguru Sivaya Subramuniyaswami, publisher of Hinduism Today, and is being built within sight of our magazine offices. Hindu temples easily last past a thousand years--when they are built upon South Indian granite bedrock. But it's taken the world's experts in concrete technology to do the same on soft Hawaiian clay with a revolutionary massive foundation that has every expectation of lasting to 3001.

First you hear the low whine of powerful diesel engines as the approaching concrete trucks strain up a nearby hill. As they near the temple site, the ground begins to rumble under 60,000 pounds of vehicle and concrete. Then, as the yellow land barge lumbers into sight, seven thundering strikes ring out from an enormous antique Balinese gong. The chanting

around the sacred yajna fire increases, and dozens of saffron-robed monks and a hundred devotees from near and far gather beside the truck. Satguru Sivaya Subramuniyaswami breaks a coconut at the auspicious moment of 6:50am under a colorful Hawaiian sky, August 21, 1999. Throughout the day, truck after truck makes the same ceremonial entrance, depositing by day's end 500 cubic yards of concrete. On August 28 the ritual is repeated and another 500 yards arrive to complete the monolithic foundation for the Iraivan Hindu Temple, 117.5 feet by 56 feet by four feet thick.

It was no ordinary construction project for the small island of Kauai in the middle of the Pacific Ocean, and this was most certainly no common man's concrete. It was so innovative a formula and method that it had no precedent. The foundation demonstrates a revolutionary method of concrete construction which, if widely adopted could save millions of dollars a year, create structures to last far longer than they do now and substantially reduce the introduction of carbon dioxide to the atmosphere--the major cause of global warming.

So how did this remote island temple land in the forefront of concrete technology and environmental salvation at the same time? It began with a vision by Gurudeva (as Subramuniyaswami is known) on February 15, 1975, of Lord Siva walking upon the land near his ashram [see Hinduism Today, December, 1998, for the full story of the temple]. To permanently enshrine the spiritual power of this astounding vision, Gurudeva resolved to create a traditional all-stone Hindu temple upon the site that would last a thousand years. It will be the first, and likely remain the only, all-stone Hindu temple built in America. Others, some smaller, some larger,

are built with modern time-saving materials--concrete, bricks and mortar, with some stone parts. The famed Dr. V. Ganapati Sthapati, one of India's greatest living architects, was selected to design the temple, and the stone carving began December, 1990, in Bangalore, India. Knowing the temple would sit upon soft clay, Sthapati specified that a concrete foundation be built which could carry four million pounds of carved stone without cracking, nor sink more than 1/8th of an inch over a twelve-foot span--ever--or else the temple's long granite roof beams would break and fall.

Concrete experts provided a quick response to his request: "Impossible!" The first optimist upon the job was architect Jim Adams of JAI Associates of Honolulu, a long-time meditator and friend of the Hawaii ashram. He designed the foundation and specified the placement of three feet of heavily compacted gravel first. But a concrete expert still had to be found willing to tackle the request for a thousand-year foundation.

Deva Rajan, owner of Canyon Construction company in Northern California, notes, "When the question gets asked, 'How do you create concrete structures to last 1,000 years?,' no one has a ready answer. I talked to engineers, architects, concrete suppliers, general contractors. Mostly, I got blank stares, light laughter and some idle questions. Truth is, in the construction industry we are never asked to perform work for this kind of longevity. In the West, we build structures to survive earthquakes and perhaps 100 years. No one builds for 1,000 years."

When Rajan offered to help solve the concrete dilemma, one of

his sons suggested he meet Kumar Mehta, professor emeritus of engineering at the University of California, Berkeley.

In a synchronicity Dr. Mehta still marvels at, he was at once being called upon to build a temple for God Siva, whom he had worshiped all his life, and fulfill his most ambitious professional goal, long-lasting concrete structures. He knew exactly how to make a foundation last a thousand years, for the technology had already been developed by the ancient Greeks and Romans but ignored by contemporary builders. Buildings stand intact today made of a special kind of concrete from that era. "High-density fly-ash concrete" was the solution [see next page], a kind of concrete in which 60% of the portland cement is replaced with fly ash, a finely powdered byproduct of coal-burning fuel plants. Fly ash concrete is cheaper than ordinary concrete, and has great environmental benefits.

But engineers are generally skeptical of the approach, and advocates such as Mehta had found no one willing to take the risk with an unproven method. There was also that other detail about the plan--use no reinforcing steel rebar at all. This engineering heresy invoked more concern than the mix formula. But the fact is, steel reinforcing bars will rust out in a matter of decades, and in the process break up the concrete surrounding them. A slab made without rebar that would not crack was a laughable expectation according to conventional wisdom. But Dr. Mehta had spent a lifetime studying exactly this problem, and he had a circle of respected engineers who agreed with him. They included W.S. Langley of Canada, who has supervised concrete quality control for billion-dollar projects. All Mehta lacked was builders willing to put their money where his theory was. Mehta joked, "I am a materials

scientist. No one has asked me even to design a driveway before." But the temple trustees were convinced Lord Siva had personally commissioned Mehta for the job, and they boldly enlisted him. The US$650,000 foundation was completed, and to this date, a month later, not a single crack has appeared, and rigorous test results show that the slab is developing the required strength to hold the granite temple.

Mehta and Langley proved able evangelists of their concepts to the contractor, SteelTech, Inc. of Honolulu, and Kauai's main concrete supplier, Hale Kauai. SteelTech's foreman, Jeff Griffins, and Hale Kauai's concrete manager, Pat DeBusca, cooperated to the fullest in making the job succeed. Mehta and Langley spent days on-island preparing for and supervising the work hour-by-hour. Though apprehensive on the first day of concrete placement (engineers don't like to call it "pouring"), the job went flawlessly. Two months' of preparatory prayer by the monks resulted in no rain either day--in a season when it normally rains several times a day, five miles from the wettest place on Earth, Mount Waialeale.

Gurudeva often said, "The temple is God's home, and He will see that it is built." In the process it

seems He is advancing concrete technology, saving money and reducing global warming. A thousand years from now this will be the only building on Kauai begun the 20th century.

Siva's New Holy Ash Makes Better Concrete

Every Hindu knows about vibhuti, the holy ash created by burning cow dung along with milk, ghee, honey, etc. It is a principle sacrament in the worship of Lord Siva, representing His burning away of our ignorance to ashes.

"Fly ash" looks just like vibhuti, and it is one of the great waste products of our modern society, accumulating by the hundreds of millions of tons yearly. Dr. Kumar Mehta of the University of California has made a life-long project of putting fly ash to use in concrete. This is possible because fly ash has "pozzuolanic" qualities. When mixed roughly half and half with portland cement in concrete, it reacts in a way that helps bind the sand and gravel together.

The ancient Romans and Greeks knew how to make something very similar to modern concrete using volcanic ash from the Italian town of Pozzuoli. They built structures such as the Pantheon, whose 140-foot diameter concrete dome stands to this day. But the technology was lost, and not rediscovered until the 19th century. Modern concrete does not use volcanic ash. Portland cement is made by heating together limestone and clay. The problem with portland cement is that for each ton produced, one ton of carbon dioxide is added to the atmosphere. Altogether, the production of portland cement is responsible for an astonishing 6 percent of man-made carbon dioxide released yearly.

Fly ash can replace half of this portland cement in concrete, thereby reducing global carbon dioxide emission by 3 percent--an astounding reduction, more than could be achieved by stopping the burning of the Amazon rain forests.

Fly ash concrete is different from normal concrete. While it ultimately is stronger than normal concrete of equivalent design, it achieves that

strength at a slower pace. The temple slab should eventually attain a strength of 7,000 psi, more than double the requirement. Ray Woodfield, an engineer attending the pour, pointed out that highway builders love concrete which reaches full strength in just two days, not three months like fly ash concrete. But it is this quick-curing concrete that is so subject to deterioration. Builders would have to adjust to a slower curing time to use fly ash.

India especially could benefit from the incorporation of fly ash in concrete. Unfortunately, its antiquated building codes specifically prohibit the use of fly ash. Mehta and Langley have conducted seminars in India on fly ash, which sits useless in small mountains next to many power plants. Their next seminar is in Chennai, in July, 2001. Mehta would especially like to see a critical change in brick making, so that kiln-fired clay bricks, a common cottage industry in India, get replaced with superior fly-ash concrete bricks--thus eliminating wood used for fuel during the firing of clay bricks, a major cause of air pollution.

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