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# KAUAI'S HINDU TEMPLE

## Unique Structure Built to Last 1000 Years has Coal Ash at its Foundation (Literally)

By John Ward

Yoginathaswami provides a tour of the Iraivan Temple construction site to Mindy Watson-Ward and the article's author, John Ward



Nestled in a verdant jungle on the garden island of Kauai, HI, construction workers patiently assemble a structure reminiscent of an ancient era that is designed to last until our own generation fades into antiquity. At the foundation of this project, quite literally, lies fly ash.

The San Marga Iraivan Temple is located on the grounds of Kauai's Hindu Monastery, a 363-acre patch of paradise that is home to Satguru Bodhinatha Veylanswami and his order of 21 swamis, yogis, and sadhakas from six nations. The monastery serves as headquarters and

theological seminary of Saiva Siddhanta Church and is home to the Himalayan Academy, *Hinduism Today* magazine, and the Hindu Heritage Endowment.

Kauai's Hindu Monastery was Founded in 1970 by Satguru Sivaya Subramuniyaswami (1927-2001), who was affectionately (and fortunately for Western tongues) known as "Gurudeva." Early in the morning on February 15, 1975, Gurudeva had a vision in which he saw Lord Siva seated on a large boulder that was later discovered on the then-overgrown monastery property. A series of subsequent mystical visions revealed

a plan for a temple to be built there and even the locations of some materials enshrined in the temple. The temple's name "Iraivan" is an ancient Tamil word for God meaning "He who is worshiped."

Mystical visions do not always mesh well with local geology, however. The site chosen for the temple was comprised of soft clay and the island did not have equipment necessary to characterize the soils deeper underground. Furthermore, the temple itself was to be constructed of heavy granite stone—3000 blocks of it, hand-carved in Bangalore, India, and then assembled on Kauai.





The Iraivan Temple rests on a 4 ft thick, unreinforced, high-volume fly ash concrete mat that remains uncracked after the first 15 years



**“...materials like fly ash and slag are complementary to portland cement, because without them, it would not be possible to build durable and sustainable concrete structures.”**





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**“Mystical visions do not always mesh well with local geology...”**

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Hand-carved stone elements of the temple include pillars shaped like lions that contain freely rotatable (but unremovable) balls in their mouths





The finished temple is comprised of 3000 granite blocks weighing more than 2000 tons

Then there was the issue of design life. The temple is designed to last 1000 years, ruling out the use of steel-reinforced concrete for the foundation. (In fact, nothing that can rust is used anywhere in the temple structure.) Designing an unreinforced concrete foundation resting on potentially unstable soils to support 2000 tons of stone for 10 centuries presented a design challenge.

Enter P. Kumar Mehta and his colleague, Wilbert S. Langley. Mehta, Professor Emeritus of Civil Engineering at the University of California, Berkeley, is

one of the pioneers of coal fly ash use in concrete. Langley, at the time President of W.S. Langley Concrete & Materials Technology Inc., was an expert in high-performance concrete and high-volume fly ash mixture proportioning.

Drawing on his knowledge of Roman pozzolanic concretes that remain in good condition after 2000 years, Mehta proposed a fly ash-based concrete mixture to be employed in a monolith mat foundation. Fly ash would be imported from the United States mainland at a cost of approximately \$200 per ton in 1999.

Design of the mat foundation had to be modified to accommodate ready mixed concrete production capacity available on the island. Only one ready mixed concrete plant was available. The plant had never used fly ash and it could furnish only 500 yd<sup>3</sup> of concrete in an 8- to 10-hour period. So the foundation—originally designed as a single 4 ft thick monolith—was altered to be placed in two courses as concrete slabs each measuring 117 x 56 x 2 ft thick.

A high volume fly ash mixture design was developed incorporating 240 lb/yd<sup>3</sup>