

HAWAIIAN CONNECTIONS



NEWSLETTER OF THE HAWAII LOCAL TECHNICAL ASSISTANCE PROGRAM

VOLUME 3, No. 3

FALL 2001

IN THIS ISSUE

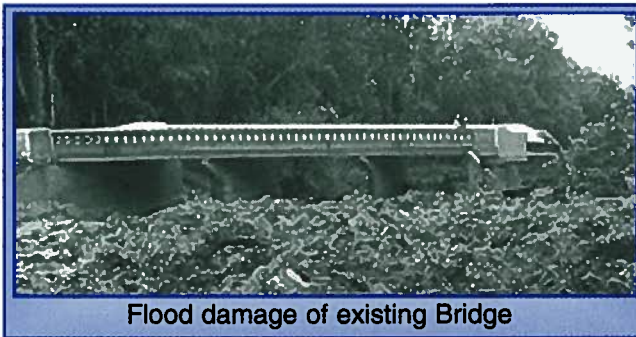
- Keaiwa Stream Bridge p. 1, 3
- Walter Lum's Rule of Thumb p. 2
- Section 106 Training p. 4, 9
- News from our partners p. 5
- Hawaii LTAP Third Quarter Summary p. 6
- Bridge Scour and Sand Plugging p. 7 - 8
- A Congratulations to Gary Choy p. 8

Please pass this on to other interested parties in your office.

KEAIWA STREAM BRIDGE BACK IN OPERATION IN 7 MONTHS!!

By *Richelle Suzuki, FHWA*
Neal Fukumoto, Wesley R. Segawa & Associates, Inc.
David Fujiwara, KSF, Inc.

a record-breaking downpour, up to 37 inches of rain in 24 hours, occurred on November 1 and 2, 2000 on the east side of the Big Island. The rainstorm caused flooding that washed out roads and bridges. The 80 foot long Keaiwa Stream Bridge in the town of Pahala, on Hawaii Belt Road, the only route around the southeast side of the Big Island, was severely damaged.



Flood damage of existing Bridge

The abutment and approaches on the south end (Pahala side) of the existing bridge were entirely washed out. Residents going into and out of this quaint, peaceful town, were greatly inconvenienced. As a result, the government had to find a way to allow vehicles to cross the stream.

The County of Hawaii, Department of Public Works, coordinated with the neighboring land owners to upgrade an existing ranch road, to allow cars to by-pass the disaster area.

This bypass allowed the Hawaii DOT, Highways, time to clear and repair 3 miles of Hawaii Belt Road as well as to determine the best course of action for the damaged bridges. The HDOT and the FHWA determined that it was best to replace the damaged Keaiwa Bridge.

The HDOT constructed a ford crossing next to the Bridge but, there was a concern that another storm could make this area impassable again. The County agreed to maintain a temporary detour road and the HDOT expedited the design and construction phases.

Continue on page 3.



How many people does it take to inspect a bridge on Oahu? Workshop highlights p. 6

Keaiwa Stream Bridge *(continued from page 1)*

Design Phase

A team consisting of Wesley R. Segawa & Associates, Inc., KSF, Inc., GeoLabs, Inc., Mitsunaga and Associates, and M&E Pacific was hired in 6 days and the design commenced November 15. The new reinforced concrete bridge consists of two abutments and seven continuous spans with expansion joints at the abutments. It is 230 feet long and has a 40-ft wide roadway with two (2) 11-ft lanes, and two (2) 9-ft shoulders. The bridge approaches, reinforced concrete wing walls and concrete rubble masonry (CRM) walls were designed to stabilize the stream's banks.

The superstructure consists of 11-inch thick prestressed-precast planks composite with six (6) inches of cast in place concrete topping. Precasting was selected to expedite the construction time. The substructure consists of six wall piers on narrow continuous footings, embedded in the basalt subgrade. The wall piers are skewed 42.5 degrees, i.e., 47.5 degrees from the longitudinal axis.

For a historical appearance, an open rail structural system consisting of reinforced concrete posts and beams was utilized.

A major challenge encountered was to design the bridge structure to respond to a peak ground acceleration of 0.8g. Response spectrum analysis showed lateral forces equal to twice the dead load. To resist these high seismic forces, the foundation was designed as a hybrid "sheet pile - continuous footing" structural system, where the passive resistance of the basalt provided the lateral and overturning restraint on the embedded portion of the wall piers.

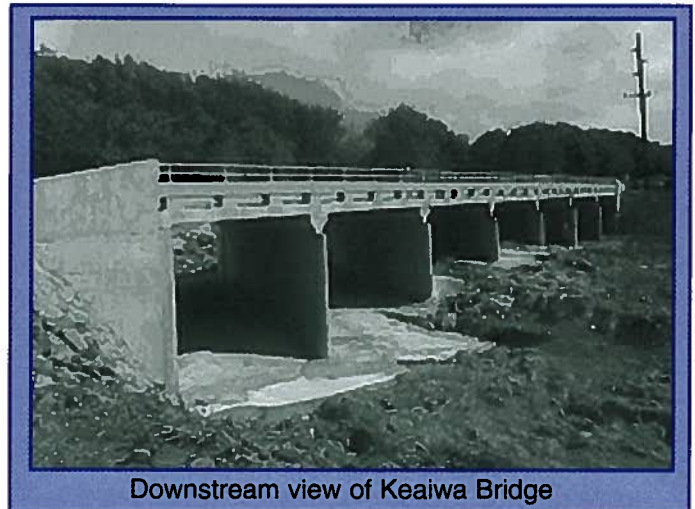
The large 42.5° skew caused high stresses in the bridge deck, due to transverse bending. 3D finite element analysis modeled the bridge as "sandwich" shell elements.

The large skew also caused the superstructure to "lock-up," due to shrinkage of the concrete topping in the deck, resulting in large tensile stresses in the center spans. A 30-day delayed poured strip was recommended over pier 3. Placing the topping on each side of pier 3 and casting the pour strip 30-days later would eliminate 50% of the shrinkage effects over the entire structure.

A total team effort among FHWA, HDOT and the Design Consultant Team enabled the design to be accomplished in six weeks, compared to a typical 6 month period.

Construction Phase

The contractor, Hawaiian Dredging Construction Company (HDCC), received the Notice to Proceed (NTP) on March 5, 2001 and immediately began work.



Downstream view of Keaiwa Bridge

To minimize construction time, the contractor requested FHWA, HDOT and KSF, Inc., to consider using a Shrinkage Reducing Admixture (SRA), such as Tetraguard AS20, in the concrete topping in the deck to reduce the shrinkage in lieu of the 30-day delayed poured strip. FHWA and KSF, Inc. performed a literature search and discovered that SRA has been used in Japan, but not in the U.S.

On April 26, it was decided to use the SRA. To determine its effectiveness and the effects of reinforcing, a research project was undertaken to monitor the shrinkage strains in the bridge deck and in eight 36 x 36 x 8 inch concrete specimens. The specimens were categorized in two groups, with and without the SRA and varying reinforcements in the four specimens within a group.

Vibrating wire strain gages were placed in the bridge deck and specimens that will be monitored for twelve months. HDCC funded the test specimen preparation and provided the SRA at no cost to FHWA and HDOT.

The bridge deck was poured on May 5 and opened to two-way traffic on May 25. The innovative solution of using the SRA allowed the roadway to be opened to traffic thirty days earlier than originally targeted.

With the cooperation and coordination of innovative, energetic, and dedicated employees from public agencies and private companies, the bridge was constructed in 7 months.

A special Mahalo to:

Hawaii Department of Transportation, Highways
County of Hawaii, Department of Public Works
Wesley R. Segawa & Associates and the Design
Consultant Team
Hawaiian Dredging Construction Company
Federal Highway Administration