

### Coal Combustion Product Type

Class F Fly Ash

### Project Location

San Francisco and Oakland, California

### Project Participants

Headwaters Resources (now Boral Resources), Pacific Cement, RMC Lone Star, CTLGroup, California Department of Transportation, T.Y. Lin International/Moffat & Nichol (joint venture), Kiewit/FCI Mansion (joint venture), Parsons Transportation Group, Schwager Davis Inc., American Bridge/Fluor (joint venture)

### Project Completion Date

2013

### Project Summary

The San Francisco–Oakland Bay Bridge is a series of spans carrying Interstate 80 approximately 4.5 miles, via Yerba Buena Island, between the two aforementioned cities. A section of the original bridge’s eastern span, which runs 1.9 miles between Yerba Buena Island and Oakland, collapsed in the 1989 Loma Prieta earthquake. Rather than upgrading the span to bolster its seismic resistance, the California Department of Transportation (Caltrans) opted to rebuild it to exacting new standards.

### Project Description

Construction of the new eastern span—which actually comprises several distinct sections, including the Self-Anchored Suspension Span (SAS) and the Oakland Touchdown—began in 2002 with its longest segment, the so-called Skyway. Initial designs considered both steel and concrete structures, with the latter winning out as the more cost-effective solution. The 1.2-mile elevated section of roadway, designed for a 150-year service life, would eventually incorporate over 12 million cubic feet of concrete and 452 precast concrete sections weighing 300 to 800 tons apiece.



Credit: California Department of Transportation.

Since 1997, Caltrans has stipulated the use of at least 25% fly ash replacement for portland cement in structural concrete mix designs to combat alkali-silica reactivity. Concrete mixes of up to 50% fly ash were used in the footings, the high salt zones, and other mass concrete components. Use of the fly ash, supplied by Headwaters Resources (now Boral Resources) prevented the cracking of the cement when it hardened, a common problem in a salt-water environment. It also helped in the concrete’s placement, as the fly ash particles’ round shape acts like ball bearings to improve flow and workability in the mix. Moreover, concrete containing fly ash is denser and stronger, making it better able to carry loads as well as prevent salt from entering the hardened product.

At the western edge of the eastern span, the SAS—the world’s longest self-anchored suspension span, at a half-mile-long—ends at a pier bent supported by four columns resting on massive concrete anchor blocks. To help achieve the stringent corrosion and thermal standards required, the concrete contained 40% fly ash. The concrete’s compressive strengths attained 9000 psi at 90 days. At the east end of the eastern span, the Oakland Touchdown’s concrete footings incorporate a 50% fly ash mix for thermal control. The average measured compressive strengths of the footing pile caps were 4630 psi and 5630 psi at 28 days and 56 days, respectively.

Other notable facts from the project, one of the largest public works projects in California’s history, include:

- Approximately 60,000 tons of fly ash used
- 30 different concrete mix designs employed
- World’s widest bridge, according to Guinness World Records
- Skyway decks comprise the world’s largest pre-cast concrete segments
- Projected lifespan is twice that of a concrete bridge built without fly ash
- Won the Environmental Protection Agency’s C<sup>2</sup>P<sup>2</sup> Innovation Award



Credit: California Department of Transportation.