Technical Bulletin 23

HVFA for Concrete Structures

IN 1981, long before using high volume fly ash (HVFA) concrete in structural applications was an accepted practice, EHDD architects used concrete with 40% fly ash in the seawater holding tanks in the Monterey Bay Aquarium for durability considerations. Since then, concrete throughout the country has regularly utilized 20% to 35% fly ash.

The desire from the environmentally-conscious community to mitigate greenhouse gas emissions has resulted in a movement to allow higher fly ash contents than would have been thought possible a few short years ago. In fact, specifiers are now regularly asking for higher fly ash content for performance and environmental reasons. This movement is forcing the concrete industry to research the nature and performance of local materials that allow HVFA concrete to perform as needed.

Performance of HVFA concrete is directly related to performance of local materials. Because of this, proportions of HVFA concrete vary from location to location. As with all concrete utilized in construction, field verification testing and trial placements should be used to make sure HVFA concrete performance meets project needs.

HVFA concrete can be used in a variety of structural applications. It has been proven as a technology that can accommodate sustainable development and improve the lifespan and performance of structures.

HVFA Concrete Timeline

Initially, HVFA projects utilized concrete with very low water contents achieved by the use of high dosages of high-range water reducing admixtures. A few of the early projects are listed below:

1987	**Satellite Communication Facility** Ottawa, Canada	50% fly ash concrete used in high durability concrete
1988	**Park Lane Hotel/Office Complex** Halifax, Canada	55% fly ash concrete used in columns, beams, and floor slabs
1990	**Purdy's Wharf Development** Halifax, Canada	55% fly ash concrete used in 62 large caissons
1992	**Slope Protection Project** Nova Scotia, Canada	60% ash used in shotcrete slope protection
1999	**GAP Headquarters Building** San Francisco, CA	50% fly ash concrete in pile caps and slab-on-grade work; 30% used in column and slab-on-metal deck work
2000	**Island Wood Environmental Learning Center** Whidbey Island, WA	50% fly ash concrete in footings, stem-walls, and slab-on-grade
2000	**Liu Centre for Global Studies** Vancouver, Canada	50% ash for foundation and structural elements
2001	**Artist Live/Work Studios** Vancouver, Canada	50% fly ash concrete for architectural color and finish considerations
2001	**University of California Berkeley** Berkeley, CA	50% fly ash concrete used in Wurster Hall and Barker Hall seismic retrofits

Further research into proportioning HVFA concrete mixtures revealed that higher water content could be used while maintaining acceptable performance. This opened the door for the use of mid-range water reducing admixtures and more "user-friendly" concrete. The following HVFA concrete projects were built with the new mix ideology:

Many other structures are either underway or in planning as the sustainable building movement develops.

Admixtures

Aggregate proportioning techniques that take advantage of the workability offered by HVFA generate a least voids condition in concrete, which complements the water reducing action of fly ash. Concurrent with the demand for higher fly ash contents, mid-range and high-range chemical admixtures have been developed to further enhance water-reducing action without causing an unacceptable delay in setting time. Non-chloride set accelerating admixtures have proven useful for controlling set time within contractor requirements for finishing time.

Much of the set time retardation experienced with older HVFA mixtures resulted from past practices using high dosages of older Type A water reducing admixtures on total cementitious materials. Type A admixtures can still be used in moderate dosages based on cement content, but set time can be improved if Type A admixtures are used in conjunction with mid-range and high-range chemical admixtures.

Appropriate Applications

HVFA concrete can be used in a variety of structural applications. Fly ash has not only been used regularly in massive concrete applications, but has been used in columns, shear walls, and floor slabs as well. Even though technology has improved HVFA concrete performance, some mixtures may be inappropriate for certain applications requiring very early age performance. Mixtures with 25% to 55% fly ash may be acceptable, depending upon conditions, for mass concrete and foundation applications. Where higher percentages of ash are used, the age of strength acceptance may need to be extended to 56 or 90 days. Column and shear wall work can generally accept 30% to 35% fly ash, especially when time of form-stripping is of concern. Higher cement content (20% to 30% depending on circumstances) may be required to provide appropriate finishing time for slab-on-metal deck exposed to cool temperatures and for achieving strength of 3000 psi at three days of age for post-tensioned concrete applications.

For more information or answers to questions about the use of fly ash in specific applications, contact your nearest Headwaters Resources Technical Sales Representative or call 1-888-236-6236.

HEADWATERS RESOURCES
10701 S. River Front Parkway, Suite 300
South Jordan, UT 84095
www.flyash.com