

FLY ASH AND NATURAL POZZOLANS USED IN CONCRETE

IR 19-3

References:

California Code of Regulations (CCR), Title 24, Part 2, California Building Code (CBC)
2007 CBC, Section 1903A.5
2010 CBC, Section 1903A.4
ACI 318-05, ASTM C 618, ASTM C 311, ASTM C 94

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Discipline: Structural

This Interpretation of Regulations (IR) is intended for use by the Division of the State Architect (DSA) staff, and as a resource for design professionals, to promote more uniform statewide criteria for plan review and construction inspection of projects within the jurisdiction of DSA which includes State of California public elementary and secondary schools (grades K-12, community colleges) and state-owned or state-leased essential services buildings. This IR indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered by DSA.

This IR is reviewed on a regular basis and is subject to revision at any time. Please check the DSA web site for currently effective IRs. Only IRs listed in the document at www.dgs.ca.gov/dsa/publications at the time of plan submittal to DSA are considered applicable.

Purpose: This IR provides general requirements for acceptance and use of concrete mixes containing a significant amount of fly ash or natural pozzolans as a substitute for Portland cement, for projects under DSA jurisdiction. This IR describes the DSA requirements for the use of fly ash, which also apply to the use of raw or calcined natural pozzolans.

Scope: This IR is applicable for all concrete mixes utilizing fly ash or natural pozzolans in excess of 15% by weight, per the 2010 California Building Code (CBC), Section 1903A.4 (Section 1903A.5 in the 2007 CBC).

This IR does not address issues related to constructability, curing, rate of strength gain, admixture compatibility, or sampling and testing. The design professional in responsible charge of the project shall clearly delineate all special requirements or procedures in the construction documents. Individuals experienced in the use of concrete mix designs using fly ash should be consulted, especially for mixes exposed to freeze / thaw or deicing chemicals.

Background: Conventional or “standard” concrete mixes, as the term is used in this IR, typically contain from 0 to 15% fly ash by weight. The percentage of fly ash is usually expressed as the percent fly ash, by weight, of all the cementitious materials (cement and fly ash) in the mix. Because Class F fly ash is a by-product of the combustion of coal, a concrete mix containing significant amounts of fly ash is being recognized as a “green” product. Compared to Portland cement, it offers these environmental benefits:

- Diverts material from the waste stream
- Reduces green house gas emissions from the processing of raw material
- Conserves raw material

There are other benefits such as improved workability and durability, reduced permeability and water demand, and lower heat of hydration. However, there are also some drawbacks such as extended curing time, and slower early strength gain, which may impact testing and handling of samples, and construction schedules (e.g.: form and shoring removal). A special strength testing specification may be necessary.

1. Material:

1.1 Fly Ash: Fly ash and raw or calcined natural pozzolans shall meet the American Society of Testing and Materials (ASTM) standard specification C 618-08a (C 618-05 for projects submitted under the 2007 CBC) for Class N or F (Class C fly ash is not permitted). Per ASTM C 618, sampling and testing of fly ash shall be in accordance with ASTM C 311.

Additional requirements for fly ash are as follows:

- Fly ash shall be supplied by an experienced producer that complies with all applicable standards (e.g. ASTM C 618, ASTM C 311).
- Fly ash shall be from one source for the duration of the project unless additional physical testing of the changed mix is preformed, per Section 2 below.

1.2 Other Material Components: All other materials used in the concrete mix shall meet the requirements of Chapter 3 of ACI 318.

2. Concrete Mix Designs:

2.1 General: For all mix designs, concrete proportions shall be selected by a registered civil engineer with experience in concrete mix design, and shall be determined in accordance with the provisions of ACI 318, Section 5.2. All mix designs shall be identified by a mix design identification number. The civil engineer shall prepare and submit a mix design report to the DSA approved (LEA) testing laboratory for review.

Mix design reports shall include all the data as required to verify conformance with ACI 318, Section 5.2 and 5.3, and the following:

- The mix design identification number
- Cement certification
- Fly ash certification of compliance or test data
- Admixture data
- Aggregate test data

The report shall also bear the signature and seal of the registered engineer responsible for proportioning in accordance with *IR A-19: Design Professional's Signature and Seal (Stamp) on Construction Documents*, Section 1.1.

2.2 Mix Designs Utilizing 15% Or More Fly Ash: Proportioning shall be based on field experience or trial mixtures, or both, per ACI 318, Section 5.3. Proportioning per ACI 318, Section 5.4 (without field experience or trial mixtures) is not permitted.

2.3 Mix Design Review and Approval Process: An engineer from a DSA approved (LEA) testing laboratory shall review the mix design report and the design professional in responsible charge of the project shall approve the mix design.

2.3.1 Review by LEA Engineer: A qualified civil engineer associated with a DSA approved (LEA) testing laboratory shall review the report for conformance with ACI 318, Sections 5.2 and 5.3. He shall issue an evaluation report of findings and recommendation for either acceptance or rejection and forward his report to the design professional in responsible charge of the project.

2.3.2 Approval by the Project Engineer in Responsible Charge: Based on the findings and recommendation of the LEA engineer's evaluation report, the project design professional in responsible charge decides whether to accept or reject the mix design. He will issue a letter stating his acceptance or rejection. The letter shall be sent to DSA, and copied to the project inspector, the LEA laboratory, and the mix design engineer.

2.3.3 Documentation by the Concrete Supplier: The concrete supplier shall submit copies of the cement certification, fly ash certification of compliance or test data, admixture data, aggregate test data, and mix design identification number to the project inspector and the LEA engineer who reviewed the mix design report.

Record Keeping: The LEA engineer and project inspector shall maintain a copy of the approved mix design report, the approval letter from the engineer in general responsible charge, and the documents submitted by the concrete supplier and make them available to DSA upon request.