USE OF RECYCLED CONCRETE AGGREGATES

IR 19-4

References: Issued 01-12-11

California Code of Regulations (CCR), Title 24
Part 2: California Building Code (CBC), Section 1903A, 1903.1*
American Concrete Institute (ACI) 318-05, Chapter 3
ASTM C33-03 and C330-05
DSA IR 19-3 – Fly Ash and Natural Pozzolans Used in Concrete

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.

* Indicates alternative 2010 CBC sections that may be used by community colleges, per 2010 CBC, Section 1.9.2.2.

Purpose: The purpose of this Interpretation of Regulations (IR) is to clarify the use and acceptance of recycled concrete aggregate on projects under the purview of the Division of the State Architect (DSA).

Background: Construction and demolition (C&D) materials make up about 22 percent of California's disposed waste stream, or approximately 8.7 million tons, of which over 977,000 tons (or 2.4%) are asphalt and concrete. Recycling of concrete benefits the environment by reducing the waste stream at the landfills and lessens the need to extract raw materials from the land.

There are three ways concrete is recycled:

- **Blending** of plastic concrete that was returned from a previous delivery with fresh concrete.
- **Reclaimed** aggregate from plastic concrete by washing away the cementitious material.
- **Recycled** concrete aggregate formed by crushing, sizing, washing, and screening existing hardened concrete.

1. CONDITIONS OF USE:

1.1 Blending of Plastic Concrete: The application of unused plastic concrete blended with fresh concrete is prohibited on DSA projects.

1.2 Reclaimed Aggregates from plastic concrete may be used under the following conditions:

- Coarse aggregate may be used in all concrete,
- Coarse and fine aggregate may be used only in exposed minor concrete applications such as sidewalk, curb, gutter, parking strip, and pavement in an amount not to exceed 50% of the total dry aggregate mass,
- Thoroughly cleaned and washed before use,
- Must not contain any deleterious materials, and
- Must meet the requirements of the California Building Code, and its referenced standards, i.e. ASTM C33, and
- Satisfy specific project requirements

1.3 Recycled Concrete Aggregates (RCA) are not permitted in structural concrete. RCA may be used for concrete base, pipe bedding, landscape, exposed minor concrete applications such as, sidewalk, curb, gutter, parking strip, and pavement provided all the following requirements are met:

- Source of recycled aggregates are identified,
- Use of recycled fine aggregates in concrete is prohibited,
- Use of recycled coarse aggregates from salt contaminated concrete pavements is prohibited,
- Thoroughly cleaned and washed before use,
- Contain no deleterious materials,
- Meet the requirements of the California Building Code and its referenced standards, i.e. ASTM C33,
- Satisfy specific project requirements, and
- When used in minor concrete, the amount shall be limited to no more than 50% of the total dry aggregate mass.

2. MIX DESIGN: Concrete mix designs using recycled coarse aggregates shall comply with the provisions of DSA IR 19-3, Section 2.

3. SPECIAL CONSIDERATIONS: Concrete mix designs must account for the physical properties and characteristics of recycled aggregates, such as:

3.1 Recycled Concrete Aggregates (RCA):

- Angular with rough surfaces
- Higher water absorption
- Lower density
- Higher abrasion loss
- May fail sulfate soundness test
- May contain higher level of sodium chloride

3.2 Concrete Made with RCA:

3.2.1 Fresh Concrete

- Harsh due to angularity and roughness of RCA
- Slump loss
- High water content
- Higher air content

3.2.2 Hardened Concrete

- Lower compressive and flexure strengths
- Lower stiffness, i.e. modulus of elasticity
- Higher resistance to freeze-thaw
- May be more susceptible to alkali silica reaction
- Higher creep and dry shrinkage

4. REFERENCES: For additional information, see the following references:

- ACI 555R-01, *Removal and Reuse of Hardened Concrete*, ACI Committee 555
- Report No. WA-RD 726.1, *Use of Recycled Aggregates in PCCP: Literature Search*, Washington State Department of Transportation, June 2009