

This is a guidance document with sample specification language intended to be inserted into project specifications on this subject as appropriate to the agency's environmental goals. Certain provisions, where indicated, are required for U.S. federal agency projects. Sample specification language is numbered to clearly distinguish it from advisory or discussion material. Each sample is preceded by identification of the typical location in a specification section where it would appear using the SectionFormat™ of the Construction Specifications Institute; the six digit section number cited is per CSI Masterformat™ 2004 and the five digit section number cited parenthetically is per CSI Masterformat™ 1995.

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### SECTION 03 30 00 (SECTION 03300) - CAST-IN-PLACE CONCRETE

SPECIFIER NOTE:

*resource management:* Improper mining of raw materials (aggregate and components of portland cement: limestone, oxides of calcium silicon, clay, shale, and sand) can produce soil erosion, pollutant runoff, and habitat loss. Materials for concrete and cement manufacture (aggregates, portland cement, supplementary cementitious materials, and water) are found throughout the US, allowing for minimal shipping distances, yet localized depletion of these resources may occur. Supplementary cementitious materials consist of natural pozzolans and recycled products from other industries. Natural pozzolans include: diatomaceous earths, volcanic ash, and pumicites. Recycled supplementary cementitious content materials for pozzolanic concrete include: fly ash, slag cement, and silica fume. Recycled concrete can also be used in concrete or as a subbase material.

Many cement manufacturing facilities are reducing their CO<sub>2</sub> emissions through energy efficiency improvements and through increased use of waste lime (instead of converting limestone to lime), and scrap tires.

Resource efficient options for permanent formwork include earth forms and insulated, panels or blocks made from expanded polystyrene (beads or extruded), known as insulated concrete forms. Temporary forms (metal pan forms, wood forms, and corrugated paper forms) are generally reusable and easily recyclable. Most typically contain recycled content.

*toxicity/IEQ:* The production of portland cement generates significant volumes of CO<sub>2</sub>, a significant greenhouse gas.. By volume, a concrete mix typically consists of 10 to 15 percent portland cement or other cementitious material. Some facilities have reduced their CO<sub>2</sub> emissions through energy efficiency improvements and through increased use of waste lime (instead of converting limestone to lime). Approximately 50 percent of the kilns in North America use hazardous waste as fuel. Wastes such as spent solvents, printing inks, paint residues, and cleaning fluids often are designated as hazardous because they are flammable and have high fuel values. These materials can be burned to destruction as fuel in a cement kiln at temperatures of about 2700 F (1480 C) while reducing the need to use fossil fuels. There is controversy over the burning of waste materials (tires, MSW, and hazardous materials) in cement kilns. The EPA and the Cement Kiln Recycling Coalition are addressing citizen concerns.

Concrete is relatively inert once cured. Admixtures, curing compounds, and sealers may emit VOCs, especially during the curing process; however, virtually all emissions are eliminated before enclosing the building.

Hazardous materials may also be "encapsulated" by being mixed with or imbedded in nonporous, durable concrete, commonly known as solidification and stabilization. However, it is necessary to consider future disassembly and possible options for recycling concrete that has "encapsulated" hazardous materials.

*performance:* Performance in place is comparable for green methods and standard methods. Concrete construction provides thermal mass, fire resistance, and durable construction. The thermal mass effect has been proven to reduce heating and cooling loads in most climates. Concrete structures can be designed to last in excess of 100 years which will result in lower repair and reconstruction resources. The coefficient of reflectivity of concrete allows reduced need for lighting and subsequent electricity when used

for paving of roads and parking areas. Steel reinforcing may be separated with magnets from concrete aggregate during recycling operations. Separation of plastic from concrete aggregate may require water to float plastic shards.

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes:
1. Formwork.
  2. Reinforcing.
  3. Cast-in-Place Concrete.
  4. Accessories.

### 1.2 SUBMITTALS

- A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

#### SPECIFIER NOTE:

Green building rating systems often include credit for materials of recycled content. USGBC-LEED™ v2.2, for example, includes credit for materials with recycled content, calculated on the basis of pre-consumer and post-consumer percentage content and it includes credit for use of salvaged/recovered materials. Green Globes US also provides points for reused building materials and components and for building materials with recycled content.

1. Recycled Content:
  - a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
  - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
  - c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
  - d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

#### SPECIFIER NOTE:

Specifying local materials may help minimize transportation impacts; however it may not have a significant impact on reducing the overall embodied energy of a building material because of efficiencies of scale in some modes of transportation.

Green building rating systems frequently include credit for local materials. Transportation impacts include: fossil fuel consumption, air pollution, and labor.

USGBC-LEED™ v2.2 includes credits for materials extracted/harvested and manufactured within a 500 mile radius from the project site. Green Globes US also provides points for materials that are locally manufactured.

Concrete ready-mix plants are so numerous across the US that they are generally within 50 miles (80 km) of most job sites. Supplementary cementitious materials, portland cement, and the raw materials for cement are also generally extracted and manufactured within 500 miles (800 km) of a job site.

2. Local/Regional Materials:
  - a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
  - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
  - c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.

- d. **Product Component(s) Value:** Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

**SPECIFIER NOTE:**

The Farm Security and Rural Investment Act, Section 9002, Federal Procurement Of Biobased Products, requires each Federal Agency to develop a procurement program which will assure that items composed of biobased products will be purchased to the maximum extent practicable and which is consistent with applicable provisions of Federal procurement law. USDA designates biobased products for preferred Federal procurement and recommends biobased content levels for each designated product. USGBC-LEED™ v2.2 includes credits for use of rapidly renewable materials, which USGBC describes as plants harvested within a ten-year cycle. Green Globes – US, provides credit for integration of materials from renewable sources that have been selected based on life-cycle assessment.

3. **Biobased materials:**
  - a. Indicate type of biobased material in product.
  - b. Indicate the percentage of biobased content per unit of product.
  - c. Indicate relative dollar value of biobased content product to total dollar value of product included in project.

**SPECIFIER NOTE:**

USGBC-LEED™ v2.2 includes credit for use of sustainably harvested wood certified under Forest Stewardship Council Guidelines. Under LEED™ v2.2, a minimum of 50 percent of wood-based materials and products incorporated into the Project must be certified in accordance with the Forest Stewardship Council Guidelines. .  
Green Globes US also provides points for wood products that originate from certified sources, such as, Forest Stewardship Council, Sustainable Forestry Initiative, and the CSA Sustainable Forest Management Program.

- B. **Letter of Certification(s) for Sustainable Forestry:**
  1. **Forest Stewardship Council (FSC):** Provide letter of certification signed by lumber supplier. Indicate compliance with FSC "Principles for Natural Forest Management" and identify certifying organization.
    - a. Submit FSC certification numbers; identify each certified product on a line-item basis.
    - b. Submit copies of invoices bearing the FSC certification numbers.
  2. **Sustainable Forestry Board:** Provide letter of certification signed by lumber supplier. Indicate compliance with the Sustainable Forestry Board's "Sustainable Forestry Initiative" (SFI) and identify certifying organization.
    - a. Submit SFI certification numbers; identify each certified product on a line-item basis.
    - b. Submit copies of invoices bearing the SFI certification numbers.
  3. **Canadian Standards Association (CSA):** Provide letter of certification signed by lumber supplier. Indicate compliance with the CSA and identify certifying organization.
    - a. Submit CSA certification numbers; identify each certified product on a line-item basis.
    - b. Submit copies of invoices bearing the CSA certification numbers.

**PART 2 - PRODUCTS**

**SPECIFIER NOTE:**

EO 13423 includes requirements for Federal Agencies to use "sustainable environmental practices, including acquisition of biobased, environmentally preferable, energy-efficient, water-efficient, and recycled-content products"

Specifically, under the Sustainable Building requirements per Guiding Principle #5 Reduce Environmental Impact of Materials, EO13423 directs Federal agencies to “use products meeting or exceeding EPA’s recycled content recommendations” for EPA-designated products and for other products to “use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project.”

Additionally, for USDA-designated biobased products, Federal agencies must use products meeting or exceeding USDA’s biobased content recommendations; and for other products, biobased products made from rapidly renewable resources and certified sustainable wood products.

And, under the Sustainable Building requirements per Guiding Principle #4 Enhance Indoor Environmental Quality, EO13423 directs Federal agencies to use “materials and products with low pollutant emissions, including adhesives, sealants, paints, carpet systems, and furnishings.”

## 2.1 FORMWORK

### A. Wood forms:

1. Lumber as specified in Section 06 10 00 (06100) – Rough Carpentry.
2. Sheathing as specified in Section 06 16 00 (06160) - Sheathing.

### B. Plastic forms: Plastic lumber as specified in Section 06 60 00 (06600) – Plastic Fabrications.

#### SPECIFIER NOTE:

Green building rating systems often include credit for materials of recycled content and may distinguish allowable credit for post-consumer and post-industrial (or pre-consumer) recycled content. USGBC-LEED™ v2.2, for example, factors 100 percent of post-consumer recycled content but only 50 percent of pre-consumer (post-industrial) recycled content into calculations for its recycled content materials credit. LEED v2.2 grants one credit to a project for using materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 10 percent of the total value of the materials in the project; 10% (post-consumer + 1/2 post-industrial). It grants an additional point for 20% (post-consumer + 1/2 post-industrial).

Green Globes US also provides points for reused building materials and components and for building materials with recycled content.

Recycled content is typically determined by calculating the weight of the recycled material divided by the total weight of the product and expressed as a percentage by weight. (The recycled content “value” of a product as assessed under LEED is determined by multiplying the recycled content percentage and the cost of the product.)

Supplementary cementitious materials, such as fly ash, silica fume, and slag cement are typically considered pre-consumer recycled material. Furthermore, using recycled aggregates such as slag instead of extracted aggregates may qualify as pre-consumer. Using recycled concrete as aggregates may qualify as post-consumer.

Verify with manufacturer for product availability and recycled content.

1. Recycled Content: Minimum **[5] [10] [xxxx]** percent post-consumer recycled content, or minimum **[20] [40] [xxxx]** percent pre-consumer recycled content at contractor’s option.

### C. Insulating Concrete Forms:

#### SPECIFIER NOTE:

The Expanded Polystyrene (EPS) used in insulating concrete forms are not typically made from recycled material. However, the plastic webs and connectors may be made from recycled material.

Verify with manufacturer for product availability and recycled content.

1. Recycled Content: Minimum **[5] [10] [xxxx]** percent post-consumer recycled content, or minimum **[20] [40] [xxxx]** percent pre-consumer recycled content at contractor’s option.

2. Toxicity/IEQ: No CFCs, HCFCs and other ozone-depleting substances used or released during manufacture.
- D. Carton forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set.
1. Recycled Content: Minimum **[5] [10] [xxxx]** percent post-consumer recycled content, or minimum **[20] [40] [xxxx]** percent pre-consumer recycled content at contractor's option.
- E. Form Release Agent: Colorless biobased oil which will not stain concrete.

**SPECIFIER NOTE:**

For current designations under the Federal Biobased Products Preferred Procurement Program (FB4P), refer to [www.biobased.oce.usda.gov](http://www.biobased.oce.usda.gov). As of March 16, 2006, the Federal Register includes the final rule designating the first six items, which are generic groupings of biobased products. The items are: mobile equipment hydraulic fluids; biobased roof coatings; water tank coatings; diesel fuel additives; penetrating lubricants, and; bedding, bed linens and towels. Refer to 7 CFR Part 2902, Designation of Biobased Items for Federal Procurement; Final Rule. The requirements for purchasing biobased items apply to those items directly purchased by the federal agency. Under a construction contract, the contractor's use of hydraulic fluid in its bulldozers and backhoes is incidental to the purpose of its contract, so the contractor is not required to use biobased hydraulic fluids. The Office of the Federal Environmental Executive (OFEE) recommends that agencies encourage the use of these items, however.

This is the first of a series of rules that will be issued designating biobased items. The USDA proposed to designate 20 additional items, including several used in construction, on August 17, 2006. Proposed minimums for biobased content of building materials include the following:

- Carpet: 7 percent
- Insulating Foam for Wall Construction: 8 percent
- Composite Panels (non-structural): 26 percent

The USDA currently has identified about 150 items for which it is collecting test data needed for the additional designations of items that will extend preferred procurement status to include all qualifying biobased products.

Concrete release agents and sealers are scheduled for proposed biobased definitions in the next Round (Round 4) of items.

1. Biobased Content: Minimum **[xxxx]** percent soy-based oil or other biobased material.
2. Toxicity/IEQ: **[Low] [Zero]** VOC.

## 2.2 REINFORCING

**SPECIFIER NOTE:**

US-EPA Comprehensive Procurement Guidelines (CPG) discusses steel manufactured in either a Basic Oxygen Furnace (BOF) or an Electric Arc Furnace (EAF). Steel from the BDF process contains 25-30 percent total recovered materials, of which 16 percent is post-consumer steel. Steel from the EAF process contains a total of 100 percent recovered steel, of which 67 percent is post-consumer. Most reinforcing bar in the US is manufactured from recycled steel.

Recommendations for recycled content in steel reinforcing are not stated.

- A. Steel Reinforcing:
1. Recycled Content: Minimum **[5] [10] [xxxx]** percent post-consumer recycled content, or minimum **[20] [40] [xxxx]** percent pre-consumer recycled content at contractor's option.
- B. Fibrous Reinforcing: **[Plastic] [Steel]**

1. Recycled Content: Minimum **[5]** **[10]** **[xxxx]** percent post-consumer recycled content, or minimum **[20]** **[40]** **[xxxx]** percent pre-consumer recycled content at contractor's option.
- C. Chairs and bolsters: **[Plastic]** **[Steel]**
1. Recycled Content: Minimum **[5]** **[10]** **[xxxx]** percent post-consumer recycled content, or minimum **[20]** **[40]** **[xxxx]** percent pre-consumer recycled content at contractor's option.

## 2.3 CONCRETE MATERIALS

### SPECIFIER NOTE:

Coal fly ash is a byproduct of coal burning at electric utility plants. It is called "fly" ash because it is transported from the combustion chamber by exhaust gases. Slag is a byproduct of iron blast furnaces. The hot slag is quenched with water and ground into granules finer than Portland cement. The resulting product, called slag cement, can be used as an ingredient in concrete. Typical replacement rates are discussed on the Slag Cement Association's website: [http://www.slagcement.org/image/123800\\_c\\_sU128801\\_s\\_i185530/No2\\_Proportioning.pdf](http://www.slagcement.org/image/123800_c_sU128801_s_i185530/No2_Proportioning.pdf). Air-cooled slag can be used as an aggregate in concrete.

US-EPA Comprehensive Procurement Guidelines (CPG) recommend allowing for the use of coal fly ash or slag cement, as appropriate. Due to variations in coal fly ash, slag, cement, strength requirements, costs, and construction practices, EPA does not recommend recovered materials content levels for cement or concrete containing coal fly ash or slag.

- A. Fly ash: Comply with ASTM C618; Class **[N]** **[F]** **[C]**. Report the chemical analysis of the fly ash in accordance with ASTM C311. Evaluate and classify fly ash in accordance with ASTM D5759.
  1. Recycled Content: Minimum **[20]** **[40]** **[xxxx]** percent pre-consumer recycled content at contractor's option.
- B. Slag Cement: Comply with ASTM C989; Grade **[80]** **[100]** **[120]**.
  1. Recycled Content: Minimum **[20]** **[40]** **[xxxx]** percent pre-consumer recycled content at contractor's option.
- C. Silica Fume: Comply with ASTM C1240.
  1. Recycled Content: Minimum **[20]** **[40]** **[xxxx]** percent pre-consumer recycled content at contractor's option.
- D. Aggregate: Recycled porcelain, concrete, stone, or other recycled content material conforming to requirements of mix design.
  1. Recycled Content: Minimum **[5]** **[10]** **[xxxx]** percent post-consumer recycled content, or minimum **[20]** **[40]** **[xxxx]** percent pre-consumer recycled content at contractor's option.

## 2.3 ACCESSORIES

- A. Curing Compounds, Sealers, and coatings: Water-based.
  1. Toxicity/IEQ: **[Low]** **[Zero]** VOC.
- B. Isolation Joints: **[Rubber]** **[Cellulose]** **[xxxx]**.
  1. Recycled Content: Minimum **[5]** **[10]** **[xxxx]** percent post-consumer recycled content, or minimum **[20]** **[40]** **[xxxx]** percent pre-consumer recycled content at contractor's option.

## 2.4 FINISHED CONCRETE

**SPECIFIER NOTE:**

Silica fume is very fine pozzolanic material produced by electric arc furnaces as a byproduct of production of elemental silicon or ferro-silicon alloys. Silica fume is usually used as a replacement for 5 to 7 percent of the Portland cement. Replacement levels higher than 10 percent can lead to workability issues.

Replacement rates of coal fly ash for cement in the production of blended cement generally do not exceed 20-30 percent, although coal fly ash blended cements may range from 0-40 percent coal fly ash by weight, according to ASTM C 595, for cement Types IP and I(PM). 15 percent is a more accepted rate when coal fly ash is used as a partial cement replacement as an admixture in concrete.

According to ASTM C 595, ground granulated blast furnace slag (GGBF slag) may replace up to 70 percent of the Portland cement in some concrete mixtures. Most GGBF slag concrete mixtures contain between 25 and 50 percent GGBF slag by weight.

US-EPA Comprehensive Procurement Guidelines (CPG) recommend allowing for the use of coal fly ash or slag cement, as appropriate.

Verify mix design as appropriate to project engineering requirements.

- A. Mix Design: Comply with ASTM C 595. Provide the following in lieu of Portland cement:
  - 1. Fly ash: Provide at a replacement rate of **[15] [xx]** percent.
  - 2. Slag Cement: provide at a replacement rate of **[25] [xx]** percent.
  - 3. Silica Fume: Provide at a replacement rate of **[5] [xx]** percent.

PART 3 - EXECUTION

3.X SITE ENVIRONMENTAL PROCEDURES

**SPECIFIER NOTE:**

Concrete admixtures are now available that retard the setting of concrete so effectively that a partial load can be brought back to the ready mix plant for one or two days then reactivated for use. Cured waste concrete still possesses an active cement ingredient which reduces the required virgin cement in recovered content mixes by 3 to 10 percent. Despite the recycling potential for concrete, most concrete waste in the U.S (approximately 67 percent by weight, 53 percent by volume) is landfilled. However, in many urban areas, concrete can no longer be accepted in landfills.

- A. Waste Management: As specified in Section 01 74 19 (01351) – Construction Waste Management and as follows:
  - 1. Formwork: Reuse forms to greatest extent possible without damaging structural integrity of concrete and without damaging aesthetics of exposed concrete.
  - 2. Mixing equipment: Return excess concrete to supplier; minimize water used to wash equipment.
  - 3. Moisture curing: Prevent water run-off.
  - 4. Hardened, cured waste concrete: **[Hardened, cured waste concrete may be crushed and reused as fill or as a base course for pavement.] [Hardened, cured waste concrete may be used as aggregate in concrete mix if approved by Engineer.]**

END OF SECTION