

## Specifying Portland Limestone Cement (PLC)

Specifying PLC for use in concrete is not complicated. PLC is a direct replacement for ordinary Portland cement (OPC), so it only requires one change to project specifications: Refer to **ASTM C595 Type IL** instead of ASTM C150 Type I Portland cement. **It is that simple.** If the concrete requires special properties, such as sulfate resistance, see “Special Concrete Properties” below.

Typical concrete specifications utilize ASTM C150 Portland cement. To achieve carbon emission reductions, it is important to add ASTM C595, Type IL, Blended Hydraulic Cement to the specification. Since both C150 and C595 cements provide essentially the same performance levels, the specification may be limited to C595 cement to ensure carbon emission reductions.

### Mix Designs with Portland Limestone Cement (ASTM C595, Type IL)

Proportioning, mixing, properties:

- PLC replaces ordinary Portland cement (OPC) at 1:1 ratio
- PLC allows for the same dosages of fly ash or other pozzolans, slag cement
- Little or no adjustments needed
- Minor effects on fresh and hardened properties’
  - Air content, slump, bleed potential, setting time, compressive strength

|   |  |
|---|--|
| <b>Workability</b>                        | Increase or decrease<br>No significant effect on admixtures  |
| <b>Bleeding</b>                           | Decreases with increasing limestone fineness<br>Generally, of no concern                             |
| <b>Setting time (initial, final)</b>      | Can be slight decrease with increasing limestone fineness<br>Not a concern, even up to 15% limestone |
| <b>Heat of hydration</b>                  | Slight increase at early ages (up to 48 hours), but less significant at later ages                   |
| <b>Compressive strength</b>               | Can increase slightly<br>Both early-age and long-term strengths                                      |
| <b>Scaling and freeze-thaw resistance</b> | Use same techniques as with OPC concrete mixes:<br>Proper air-void systems, curing, higher strengths |
| <b>Sulfate resistance</b>                 | Use same techniques as with OPC concrete mixes:<br>Low w/c (or w/cm) and MS or HS designations       |

### SpecsIntact

SpecsIntact is an automated system for preparing standardized facility construction specifications used worldwide by National Aeronautics and Space Administration (NASA), the U.S. Naval Facilities Engineering Command (NAVFAC), and the U.S. Army Corps of Engineers (USACE). Specification detail is available at <https://specsintact.ksc.nasa.gov/>

### DOT Construction using AASHTO Specifications

For some state DOT construction, specifications developed by the American Association of State Highway Transportation Officials (AASHTO) are used instead of ASTM. AASHTO M 85 is the specification for Portland cements; AASHTO M 240 is specification for blended cements. The technical provisions of AASHTO M 85 and M 240 are the same as those of ASTM C150 and C595 respectively, so, switching to PLC just requires reference to an M 240 Type IL cement instead of M 85 Type I.

## American Institute of Architects (AIA) MasterSpec

AIA MasterSpec includes PLC as an option under the Blended Hydraulic Cement entry. MasterSpec Section 033000 on Cast-in-Place Concrete includes the following options in Section 2.5D on Cementitious Materials:

**Portland Cement: ASTM C 150/C150M, [Type I] [Type II] [Type I/II] [Type III] [Type V], [gray] [white]**

**Blended Hydraulic Cement: ASTM C 595/C595M, Type IL, Portland-limestone cement.**

## Federal Aviation Administration (FAA) Specification

For airport construction, PLC is permitted under FAA Advisory Circular AC 150AC No: 150/5370- 10H, Standard Specifications for Construction of Airports. Item P-501, Cement Concrete Pavements, includes the following text with the option to use Type IL cements:

**501-2.2 Cement. Cement shall conform to the requirements of ASTM [ ] Type [ ].**

**The Engineer shall specify all of the following that are acceptable for use on the project:**

**ASTM C150 - Type I, II, or V. ASTM C595 - Type IP, IS, IL. ASTM C1157 – Types GU, HS, MH.**

Other cements may be specified with concurrence of the FAA.

## Testing Requirements

It is recommended that trial batching be performed to confirm expected fresh and hardened performance, just as if a new source of Portland cement were being used. Because PLCs are optimized to provide the same type of performance in concrete, your mix designs are likely to remain unchanged. Some minor adjustments may be needed, like dialing in admixture dosages or tweaking aggregate content.

## Special Concrete Properties

If special properties such as moderate sulfate resistance are required, a qualifier is added to the IL designation. The table below shows a comparison of OPC vs. PLC to meet special properties for cements specified by either ASTM C150 or C595, or their counterparts from AASHTO, M 85 or M 240.

| Cement type                  | Ordinary Portland cement<br>C150 (M 85) | Portland limestone cement<br>C595 (M 240) |
|------------------------------|---|---|
| General use                  | I                                       | IL  |
| Moderate sulfate resistance* | II, II(MS)                              | IL(MS)                                    |
| Moderate heat of hydration   | II(MH)                                  | IL(MH)                                    |
| High sulfate resistance*     | V                                       | IL(HS)                                    |
| Low heat of hydration        | IV                                      | IL(LH)                                    |

\*For additional sulfate resistance, SCMs can be used in the concrete mix.

## For More Information Contact:

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