Data Sheet

Portland-Limestone Cement

ASTM C595 and AASHTO M 240 Type IL Cement

Description

GCC ASTM C595 Type IL portland-limestone cement (PLC) meets the requirements of ASTM C595 Standard Specification for Blended Hydraulic Cement as a Type IL cement.
GCC portland-limestone cement also meets the requirements of AASHTO M 240 and CSA A3000 standards.
Portland-limestone cement reduces the environmental footprint compared to ordinary portland cement (OPC) while maintaining equivalent performance.

Uses and Applications

GCC ASTM C595 Type IL cement can be used in concrete applications including ready mix, volumetric, precast and paving. Type IL cement is used for structural components as well as general construction elements. The cement will react as normal portland cements and can be used in masonry and stucco applications.

Acceptance

- ASTM C595 Standard Specification for Blended Cement
- ASTM C1157 Standard Performance Specification for Hydraulic Cement
- AASHTO M 240 Standard Specification for Blended Hydraulic Cement
- CSA A3000 Cementitious Compendium
- ACI 225R-99 Guide to the Selection and Use of Hydraulic Cements
- ACI 318 Recognition
- ACI 301 Recognition
- Most Departments of Transportation (DOT)
- American Institute of Architects (AIA) MasterSpec
  - MasterSpec Section 0330000 on Cast-in-Place Concrete includes Type IL, portland-limestone cement in Section 2.5D on Cementitious Material
- Federal Aviation Administration (FAA) Specification
  - For airport construction, PLC is permitted Advisory Circular No: 150/5370-10H, Standard Specifications for Construction of Airports
  - Item P-501, Cement Concrete Pavements, includes the option to use Type IL cement
- Unified Facilities Guide Specification (UFGS-03 30 00)
  - UFGS updated its standard to accept Type IL in May 2021. This is the specification used by Army Corps of Engineers, Navy, Air Force and NASA

Test Reports Available on Request

- Manufacturers' Material Certification meeting the requirements of ASTM C595 Type IL cements
- ASTM C1012: Length Change of Hydraulic Cement Mortars Exposed to Sulfate Solutions
- ASTM C1702: Measurement of Heat of Hydration Using Isothermal Calorimetry

Advantages

PLC has several advantages:

- Superior finishabililty compared to OPC
- Similar or less water demand to OPC
- Excellent strength
- Lower bleeding
- Reduced carbon footprint
- Increased availability
- DOT approved

Recommendations for use

In most applications, ASTM C595 Type IL may be substituted directly for OPC. Trial mix designs should be conducted for verification of strengths and other physical properties prior to field use. Admixture dosage may need to be adjusted to obtain required field performance. Most readily available commercial admixtures and additives work normally with portland-limestone cements.

Available in

- Bulk

Safety

Safety Data Sheet (SDS) is available at GCC.com or upon request.

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GCC Plants Moving Production to Portland-Limestone Cement

What's new

GCC's U.S. plants will produce portland-limestone cement (known as PLC or Type IL) instead of ordinary portland cement (OPC).

Why it matters

Type IL means lower greenhouse gas emissions for the construction industry and consistent, high-quality products for customers. Type IL reduces concrete's carbon footprint by nearly 10% CO2 helping you reach your sustainability goals.

What it is

PLC meets ASTM C595 and AASHTO M 240 "Standard Specification for Blended Hydraulic Cements" under the Type IL designation. PLC is produced in the same manner as OPC and includes more limestone. The specification allows 5-15% limestone. The overall PLC performance in concrete is very similar to OPC cement. The Portland Cement Association (PCA) encourages the move towards blended and greener cements to meet the 2050 CO2 reduction goals. Most DOTs have added PLC to their approved products lists.

What you can do

Review your specifications to ensure you allow (or even require) use of ASTM C595 and/or AASHTO M 240. Reach out to GCC with any questions about PLC.

The Math

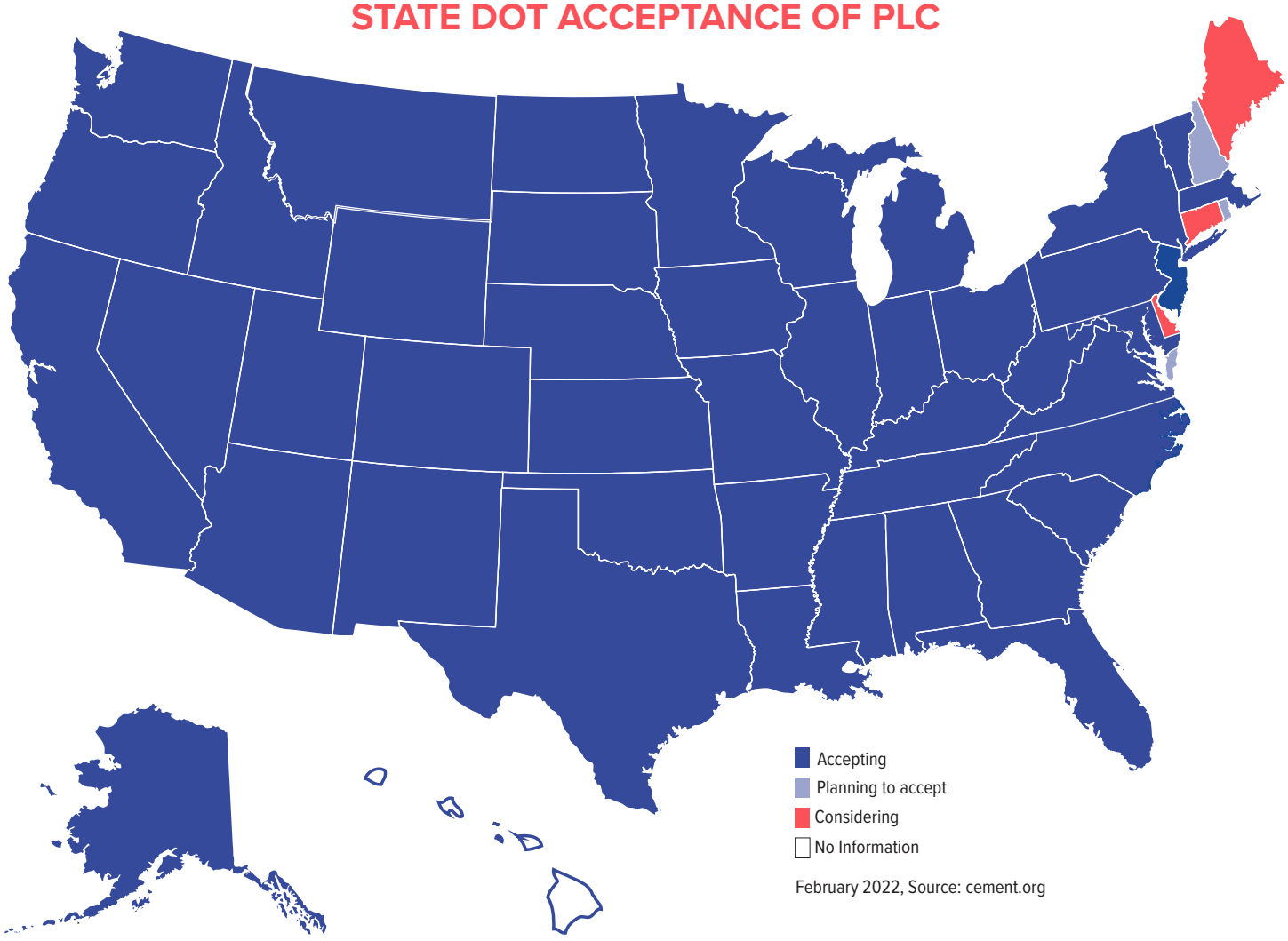
A customer that uses 10,000 tons PLC will avoid up to 600 tons of CO2. That's like taking more than 120 cars off the road for a year.

Switching 100% from OPC to PLC allows GCC to avoid 250,000 tons CO2 each year - the equivalent to keeping almost 50,000 vehicles off the roads annually.

Learn More

For more information on GCC, our products and services, please contact your local GCC market manager. Learn more about our sustainability commitment at https://www.gcc.com/sustainability/. To learn more about portland-limestone cements and how to reduce your carbon footprint, go to www.greenercement.com.

STATE DOT ACCEPTANCE OF PLC



STANDARDS AND SPECIFICATIONS

Cement and Concrete Standards

ASTM C595, AASHTO M 240, ASTM C1157, CSA A3000
ACI 301 Spec Recognition, ACI 318 Code Recognition

American Institute of Architects (AIA) MasterSpec

MasterSpec Section 0330000 on Cast-in-Place Concrete includes Type IL, Portland-Limestone Cement in Section 2.5D on Cementitious Material

Federal Aviation Administration (FAA) Specification

Airport Construction: PLC is permitted under FAA Advisory Circular No: 150/5370-10H, Standard Specifications for Construction of Airports
Concrete Pavements: Item P-501 includes the option to use Type IL cements

United Facilities Guide Specification (UFGS-03 30 00)

UFGS accepts Type IL as of May 2021. Army Corps of Engineers, Navy, Air Force and NASA follow this specification.

PLC COMPARED WITH OPC

Strengths ↔

Slightly higher at 1 and 3 days
Equivalent at 7 and 28 days

Set Time ↘

Can decrease slightly

Workability ↗

Generally better workability, PLC is creamier
No significant effect on admixtures

Fineness & Particle Size Distribution ↑

Higher fineness, wider particle size distribution

Water Demand ↔

Slump is similar

Bleeding ↔

Comparable

Modulus of Elasticity ↔

Comparable

Soundness ↔

Comparable

Soundness ↔

Comparable

Heat of Hydration ↔

Slight increase up to 48 hours, less significant at later ages

Alkali-Silica Reaction (ASR) ↔

Comparable

Sulfate Resistance ↔

Comparable

Permeability, Chloride Ingress ↔

Comparable

Efflorescence ↔

Comparable

Scaling and Freeze-Thaw Resistance ↔

Comparable, need proper air-void systems and curing

Color ↔

Slightly lighter color

MORE PLC RESOURCES

GCC Blended Cements

https://www.gcc.com/product/low-co2/

GCC Mill Certificates

https://www.gcc.com/mill-certificates/

Greener Cement (a partnership of all major construction and manufacturer associations)

https://www.greenercement.com/videos

PLC: Greener Cement | Advanced CO2 Calculator

https://www.greenercement.com/advanced-co2-calculator

PCA - Sustainability of Cement and Concrete

https://register.gotowebinar.com/recording/2808182799860731919

NRMCA CIP 45 – Portland-Limestone Cement (PLC)

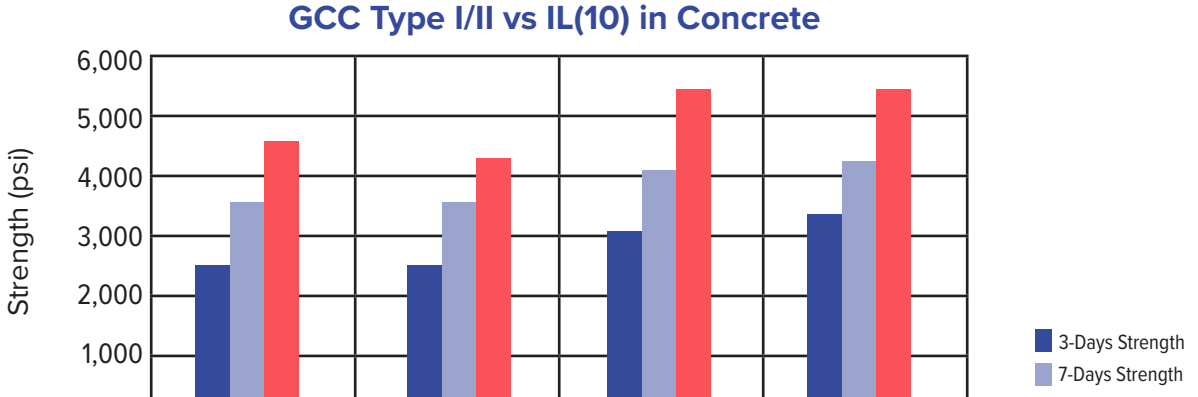
https://www.nrmca.org/wp-content/uploads/2021/10/45pr.pdf

NRMCA – Concrete in Practice CIP Series

https://www.nrmca.org/association-resources/research-and-engineering/cip/

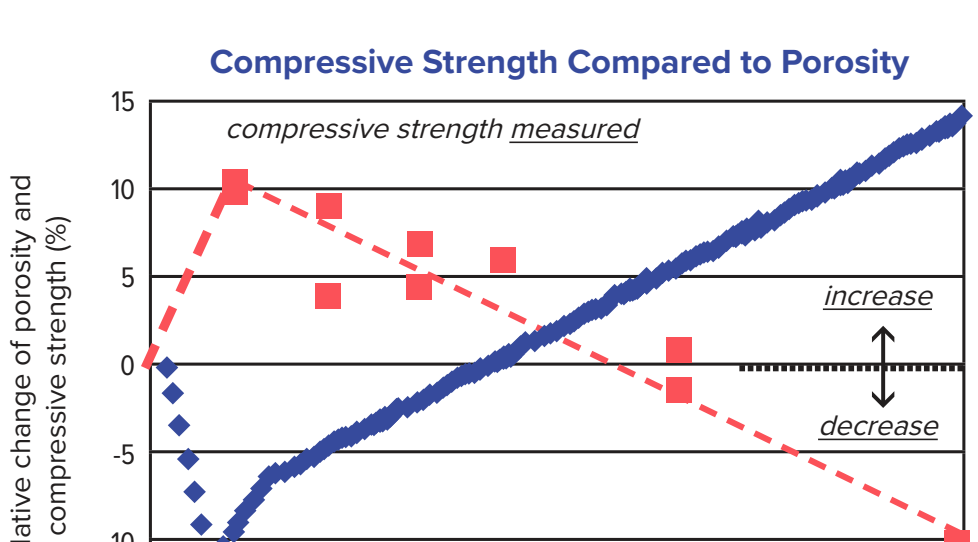
PERFORMANCE COMPARISONS

GCC Type I/II vs IL(10) in Concrete



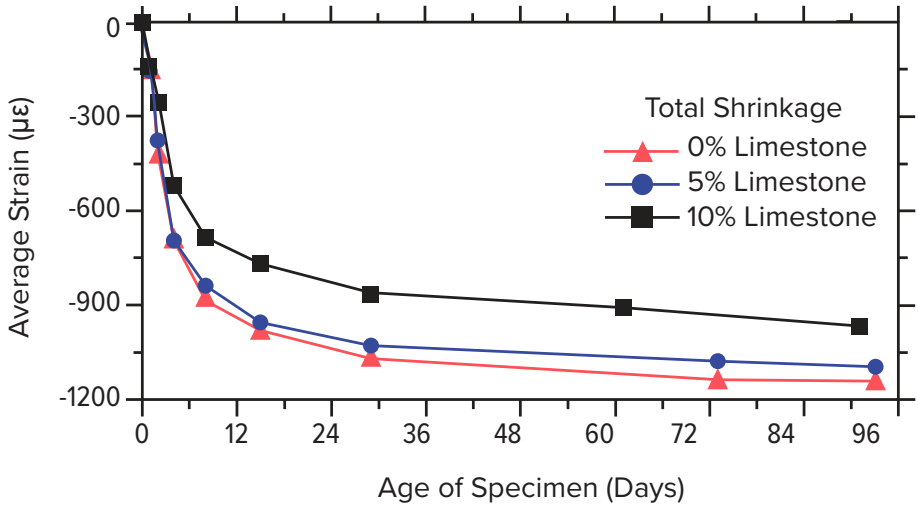
Early and late **concrete strengths** are similar in PLC and OPC. These tests have water/cement ratio of 0.49 for the 5.5 sack mix and water/cement ratio of 0.40 for the 6.5 sack mix.

Compressive Strength Compared to Porosity



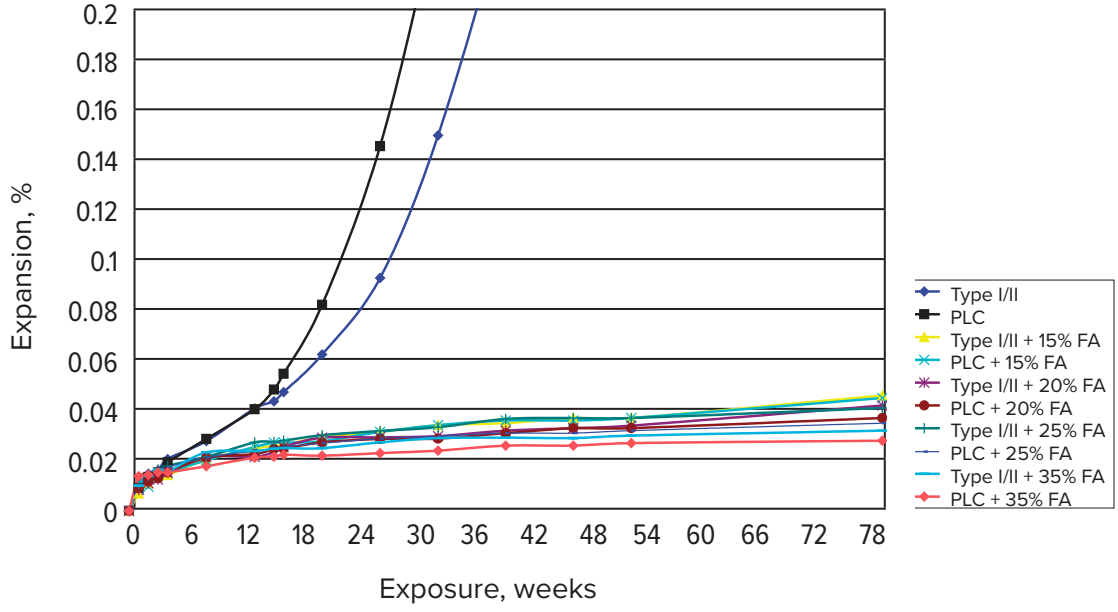
Based on European and Canadian experience, cements with up to 15% limestone can have equivalent **performance** to portland cements. The red line refers to data for the relative compressive strength at various levels of limestone. Compressive strength increases by up to 10% with 3% limestone. As limestone contents increase, strength is still higher but decreases until about 12% to 15% limestone. Thermodynamic modeling shows how porosity decreases with increasing amounts of limestone (blue line) up to about 10% or 12%. Denser mortars and concretes are stronger.

Shrinkage



Total shrinkage is the autogenous shrinkage plus the free (drying) shrinkage. Shrinkage is measurably lower at 10% limestone. (ASTM C157)

Sulfate Resistance



ASTM C1012 **Sulfate Resistance** testing with a wide range of portland cements and portland-limestone cements, with or without fly ash, shows the limestone addition has no impact.

All mixes show little expansion (<0.1%) after 18 months of exposure except for the control mixes (Type I/II and PLC) which show behavior similar to some Type I/II cements.

BUILDING A SUSTAINABLE FUTURE

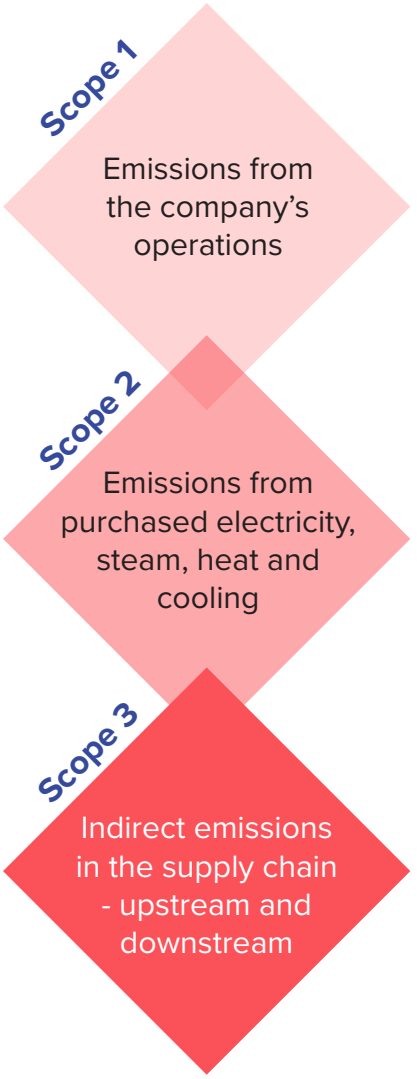
GCC's sustainability strategy focuses on reducing our overall impact on surrounding communities and the environment while creating value for all our stakeholders.

Climate Change Commitments

- United Nations "Business Ambition for 1.5 C by 2050"
- Science Base Targets (SBTi) for <2 C curve target by 2030 to be validated
- SBTi curve of 1.5 C in 2027 when we re-certify our SBTi target
- Reduce scope 1 CO2 emissions per ton of cementitious material by 28% by 2030
- Incorporate ≈75% of our electrical energy from renewable sources by 2030
  - Scope 2 emissions reduce by 53% against 2018 baseline
- Increase use of greener fuels by 2030 to reduce our CO2 footprint by ≈20%
- 2020-2030 is the decade to Get It Done
- Approximately 40% of our scope 1 emissions will be captured by developing technology

Blended Cements: Portland-Limestone Cement (PLC)

- Reduce clinker factor from 88% to 80% by 2030
  - Avoids 12% of greenhouse gases
- PLC cements with the same strength characteristics as ordinary portland cement (OPC)
- GCC is investing and optimizing cement plants to ensure PLC maintains the same strength and workability as OPC



The United Nations' Sustainability Development Goals are the foundation for GCC's 2030 sustainability targets and action plans

2030 and 2050 Roadmaps

GCC's strategy is aligned with the Global Cement and Concrete Association (GCCA) and the Portland Cement Association (PCA) roadmaps. The overall industry goal is 35% reduction in CO2 per ton of cementitious material by 2030.

Industry targets:

- 11% reduction by efficiency in concrete production
- 11% will come from changes in clinker production
- 22% reduction will come from efficiency gains in design and construction
- 9% in blended cements
- 6% in recarbonation
- 5% in renewable energy
- 36% with the utilization of carbon capture technology in development
- Net zero by 2050

NET ZERO
Building the Future

Your Next Step

- Uniform cement strength is needed for ready mix producers to optimize their concrete mix designs to reduce CO2 emissions
- Ready mix producers can reduce their CO2 emissions by limiting over-design

VISION2025
GCC

To be the best cement company in North America with the proper balance of people, profit and the planet

For more information on GCC's sustainability initiatives, visit GCC.com/sustainability/