# Portland-Limestone Cement for More-Sustainable Concrete

by Jamie Farny, Portland Cement Association

Like most industries today, the construction industry is concerned about atmospheric carbon dioxide ($CO_2$). Responding to the need for more-sustainable building materials, cement manufacturers in the United States produce several formulations of lower-carbon, blended cements called portland-limestone cements (PLCs). Because these materials may be less familiar to some segments of the construction industry, the Portland Cement Association has created a campaign to raise awareness of PLCs and the benefits they offer.

The centerpiece of the campaign is a new website: www.greenercement.com. It provides architects, specifiers, and others with practical information on how to easily implement PLCs to create durable, resilient concrete.

PLCs are engineered with a higher limestone content (5% to 15%) than portland cement (maximum 5% limestone) to reduce the carbon footprint of concrete by about 10%. Cement producers optimize PLCs to make them easy to use, and test them to ensure they meet the requirements of ASTM C595.[1] PLCs perform just like ordinary portland cement and can be substituted for it in a concrete mixture at a 1:1 replacement level, using the same specifications, the same mixture proportions, and the same delivery and installation chain.

Because so much concrete is placed each year, even small changes to its formulation can have dramatic effects on the construction industry's annual carbon footprint. Modifying a concrete mixture to replace materials that have a higher carbon footprint with lower carbon footprint ingredients is an effective strategy. PLCs offer an easy way to accomplish this, much like fly ash and slag cement have been used for decades. And concrete mixtures designed with PLCs are compatible with all supplementary cementitious materials, so substituting PLC for ordinary portland cement does not preclude the use of any other carbon-footprint-reduction strategy a designer chooses to employ.

PLCs have been subjected to extensive industry testing, both in the United States and elsewhere. The body of research points toward positive results: Concrete mixtures with PLCs require little to no adjustment to achieve similar placing and handling characteristics and durability test results as traditional concrete mixtures. And experience demonstrates that these materials are suitable for transportation infrastructure; several states have been placing PLC concrete pavements for more than a decade. PLC concretes are appropriate for structural members of any type or size, so they are good for every aspect of bridge construction—from the deck down to the foundation—even including geotechnical work that might be needed to improve soil conditions.

The cement industry has made great strides with other agencies toward the acceptance of PLCs, making it easy to transition to environmentally friendlier concrete. Just like portland cement and other blended cements, PLCs are recognized by the American Concrete Institute's *Building Code Requirements for Structural Concrete* (ACI 318-19) *and Commentary* (ACI 318R-19)[2] and *Specifications for Concrete Construction* (ACI 301-20).[3] And beyond ACI standards, PLCs are recognized by the International Code Council, the Federal Aviation Authority, and the American Institute of Architects' MasterSpec.

Since the 1970s, improvements to cement manufacturing in the United States have resulted in a more than 40% decrease in production energy while also reducing $CO_2$ emissions. As climate issues and carbon footprint come to the forefront in material selection criteria, PLCs and other blended cements give designers an easy way to lower the carbon footprint of concrete by about 10%, providing sustainable and resilient construction while helping to address global climate challenges.

## References


1. ASTM International. 2020. *Standard Specification for Blended Hydraulic Cements*. ASTM C595-20. West Conshohocken, PA: ASTM International.
2. American Concrete Institute (ACI) Committee 318. 2019. *Building Code Requirements for Structural Concrete* (ACI 318-19) *and Commentary* (ACI 318R-19). Farmington Hills, MI: ACI.
3. ACI Committee 301. 2020. *Specifications for Concrete Construction* (ACI 301-20). Farmington Hills, MI: ACI.


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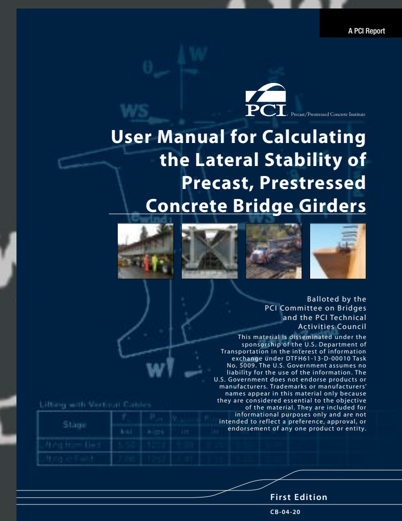


*User Manual for Calculating the Lateral Stability of Precast, Prestressed Concrete Bridge Girders* FREE PDF (CB-04-20)

This document, *User Manual for Calculating the Lateral Stability of Precast, Prestressed Concrete Bridge Girders*, PCI Publication CB-04-20, provides context and instructions for the use of the 2019 version of the Microsoft Excel workbook to analyze lateral stability of precast, prestressed concrete bridge products. The free distribution of this publication includes a simple method to record contact information for the persons who receive the workbook program so that they can be notified of updates or revisions when necessary. There is no cost for downloading the program.

This product works directly with the PCI document entitled *Recommended Practice for Lateral Stability of Precast, Prestressed Concrete Bridge Girders*, PCI publication CB-02-16, which is referenced in the *AASHTO LRFD Bridge Design Specifications*. To promote broader use of the example template, PCI developed a concatenated Microsoft Excel spreadsheet program where users may customize inputs for specific girder products.

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