

## Using Portland-Limestone Cement in Concrete Repair

**Q.** *My firm drafted the specification for the repair of structural elements in a distribution facility. The project requires removal and replacement of a relatively large volume of deteriorated concrete that was severely damaged by freezing-and-thawing cycles and corrosion due to exposure to deicing salts. From the outset, the facility owner has insisted that repairs last at least 30 years to avoid interruption of operations for maintenance. We recently learned that the local ready mixed concrete suppliers started using ASTM C595/C595M Type IL cement about a year ago. Our specification draft requires ASTM C150/C150M Type I cement, and we are concerned about achieving the requested service life of the repair with the new material. Is Type IL cement suitable for this repair application? How can we ensure that the repairs meet the owner's service-life demands?*

**A.** In recent years, portland-limestone cement (PLC) compliant with ASTM C595/C595M Type IL has become the only available cement in many regions of the country.<sup>1</sup> This change was implemented to reduce the embodied carbon in concrete while providing performance comparable to that of ASTM C150/C150M Type I cement. As of 2022, more than 40 Departments of Transportation have accepted the use of PLC for road and bridge construction.<sup>2</sup> With the increase in ASTM C595/C595M Type IL cement production, other traditionally used portland cements such as ASTM C150/C150M Type I or Type I/II have become scarce or not available. This change has made it necessary for ready mixed concrete suppliers to familiarize their staff members with PLC and, in some cases, adjust their concrete mixtures to incorporate this type of cement.

Chapter 6 of ACI CODE-562-21<sup>3</sup> provides requirements for conducting a condition assessment of a structure to gain an

understanding of the material properties of existing concrete. The condition assessment is necessary to identify if other deterioration mechanisms, such as sulfate attack or alkali-aggregate reactivity, are present. In the case where chloride penetration and reinforcement corrosion are the only durability concerns, a durable concrete repair can be achieved with the use of ASTM C595/C595M Type IL cement.

However, the addition of supplementary cementitious materials (SCMs)—accompanied by a reduction in the amount

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of portland cement—has proven to be necessary for enhancing concrete's durability when it will be subjected to aggressive environmental conditions. It is therefore likely that a concrete mixture containing PLC will need to also incorporate SCMs, so determining an optimal SCM content is very important for achieving desired fresh and hardened concrete properties for a successful repair. ACI 201.2R-16<sup>4</sup> provides guidance on using SCMs to improve concrete durability, including the resistance to chloride penetration.

More information on material selection and recommended performance of repair materials can also be found in ACI 546.3R-14<sup>5</sup> and ICRI 320.2R-2009.<sup>6</sup> In addition, both ACI 222.3R-11<sup>7</sup> and ACI 365.1R-17<sup>8</sup> provide guidance on the most important parameters for selecting the materials and proportions for concrete to be exposed to chloride ingress and potential reinforcement corrosion.

Finally, the specified service life for the repair can be accomplished in many ways, some of which are not necessarily through performance of a concrete mixture. One of the most effective service life extension methods is

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# Concrete Q&A

cathodic protection (CP), which has been used successfully for decades. If elected to be implemented, it is recommended that the project CP and system are designed by a competent specialist and installed by a certified specialty contractor.

## References

1. "PLC Availability," Portland Cement Association, Skokie, IL, [www.greencement.com/plcavailability](http://www.greencement.com/plcavailability). (Accessed Mar. 14, 2023)
2. "Worldwide Acceptance," Portland Cement Association, Skokie, IL, [www.greencement.com/acceptance](http://www.greencement.com/acceptance). (Accessed Mar. 14, 2023)
3. ACI Committee 562, "Assessment, Repair, and Rehabilitation of Existing Concrete Structures - Code and Commentary (ACI CODE-562-21)," American Concrete Institute, Farmington Hills, MI, 2021, 88 pp.
4. ACI Committee 201, "Guide to Durable Concrete (ACI 201.2R-16)," American Concrete Institute, Farmington Hills, MI, 2016, 84 pp.
5. ACI Committee 546, "Guide to Materials Selection for Concrete Repair (ACI 546.3R-14)," American Concrete Institute, Farmington Hills, MI, 2014, 72 pp.
6. ICRI Guideline No. 320.2R-2018, "Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces," International Concrete Repair Institute, St. Paul, MN, 2018, 44 pp.
7. ACI Committee 222, "Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures (ACI 222.3R-11)," American Concrete Institute, Farmington Hills, MI, 2011, 28 pp.

## Additional Online ACI Resources

The following ACI University webinars are free to ACI members:

- On-Demand Course: Repair and Rehabilitation (Part 1 and 2);
- On-Demand Course: ACI 562 Repair Code;
- On-Demand Course: Guide to ACI 562-16 Repair Code: Design Examples; and
- On-Demand Course: ACI 364 TechNotes on Repair and Rehabilitation (Part 1 and 2).

Visit [www.concrete.org/education/aciuniversity.aspx](http://www.concrete.org/education/aciuniversity.aspx) for more information.

8. ACI Committee 365, "Report on Service Life Prediction (ACI 365.1R-17)," American Concrete Institute, Farmington Hills, MI, 2017, 56 pp.

Note: Additional information on the ASTM standards discussed in this article can be found at [www.astm.org](http://www.astm.org).

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