

Concrete gains strength gradually, making it important to distinguish between early and long-term strength for safe and efficient construction. Early strength is the compressive strength achieved within the first hours to days after placement, while long-term strength is the ultimate strength reached after full curing, usually at 28 days or more.

Why Early Strength Matters?

Early strength is critical for construction activities that depend on load-bearing capacity shortly after placement, including:

- Formwork and shoring removal
- Post-tensioning operations
- Opening slabs or pavements to traffic
- Cold weather concreting, where strength gain may be slowed

Monitoring early strength often involves accelerated testing methods, field-cured cylinders, or maturity sensors embedded in concrete to estimate strength development in real time.

Why Long-Term Strength Matters?

Long-term strength reflects the concrete's ultimate performance in service. It governs durability, resistance to cracking, and load-bearing capacity over the structure's lifespan. Proper mix design, curing practices, and quality control ensure that long-term strength meets specification requirements and provides reliable structural performance.

Balancing Early and Long-Term Strength?

Mix designs can be tailored to optimize either early or long-term strength, depending on project priorities.

High early strength mixtures often rely on higher cement content, finer cement, silica fume or chemical accelerators to promote rapid strength gain. While effective at early ages, an excessive focus on early

strength can increase the risk of shrinkage, thermal cracking, and long-term durability concerns.

Mixtures containing relatively high levels of supplementary cementing materials often exhibit lower early age strength compared to mixtures based on 100% portland cement. This is because supplementary cementing materials hydrate and react at a slower rate than portland cement. However, as these reactions continue over time, such mixtures frequently achieve higher later age strengths, along with improved durability and reduced permeability.

Three Rules to Consider:

1. Monitor early strength to safely remove formwork, post-tension, or open elements to traffic
2. Ensure long-term strength for durability, load-bearing, and resistance to cracking
3. Balance mix design between early gain and long-term performance, considering cement type and supplementary materials

References

1. CSA A23.1 A23.2 2024. *Concrete materials and methods of concrete construction Test methods and standard practices for concrete.* CSA Group
2. *Design and Control of Concrete Mixtures.* 9th Edition. Cement Association of Canada

Disclaimer

The information provided above is intended for general information and educational purposes only. It does not replace project specific requirements, professional judgment, or applicable standards and codes. Readers are responsible for reviewing and complying with all project specifications, contract documents, and governing standards before applying any of the information discussed.