

Concrete in Practice

What, why & how?



CIP 31 - Ordering Ready Mixed Concrete

WHAT is Ready Mixed Concrete

Ready mixed concrete is manufactured and delivered to the customer in a freshly mixed and unhardened state. The customer is typically a concrete contractor. Ready mixed concrete is manufactured and delivered in accordance with ASTM C94/C94M, *Specification for Ready Mixed Concrete*.

There is no typical *recipe* for concrete mixtures. Concrete materials and mixture proportions vary regionally and with required properties of fresh and hardened concrete. Concrete mixture composition is best developed by the concrete producer based on requirements stated by the purchaser. Ready mixed concrete should have properties in its fresh or plastic state that will facilitate handling, placing, and finishing. In its hardened state, concrete should achieve the strength and durability properties required by the designer of the structure. These properties would depend on the anticipated loads, environmental exposure, and service conditions.

The materials for a concrete mixture are measured and mixed, either in a mixer at the concrete plant or in a concrete truck mixer. Ready mixed concrete is typically delivered in a truck mixer, which keeps the concrete in a uniformly mixed condition until it is discharged at the placement location. Concrete remains in a fresh or unhardened condition for a period of time and should be placed and finished within this period. Concrete normally sets and hardens within two to eight hours after mixing and continues to gain strength for several years if it is properly cured.

WHY Use Ready Mixed Concrete

Concrete mixtures can be customized to provide color, texture, cast in different shapes, strength, and other properties required for various applications. Concrete can be delivered at varying consistency appropriate for the placement methods. Mixtures can be proportioned for a wide range of strength levels and to be durable in diverse environmental exposures and service conditions.

Concrete can serve its function for several years with minimum maintenance, provided the proper mixture for the application and established construction practices are used.

HOW to Order Ready Mixed Concrete

The purchaser ordering concrete should provide project-specific information and keep the requirements relevant to the application. Different concrete mixtures are commonly used for the different parts of a structure. The ready mixed concrete producer maintains several mixture formulations for different applications and can help with selecting the right mixture. ASTM C94/C94M requires the purchaser to provide a copy of project specifications if one exists for a project.

When ordering concrete include the following information:

Size of coarse aggregate—the nominal maximum size of



aggregate should be smaller than the narrowest dimension through which concrete has to flow, such as the thickness of the section, space between embedments and formwork, and spacing of the reinforcing steel, if any. For most applications, the nominal maximum size of coarse aggregate used is 3/4 or 1 in. (19.0 or 25.0 mm).

Slump and Slump Flow—are measures of consistency of concrete when it is delivered. For most applications slump required is 3 to 5 inches (75 to 100 mm). For slip-form construction maximum slump of 2 inches (50 mm) is applicable, while higher slump of 7 – 9 inches (175 – 225 mm) may be needed for walls, pumped concrete, or when there is congested reinforcement. Consistency of self-consolidating concrete measured by the spread of concrete discharged from the slump cone with minimal segregation and referred to as slump flow. ASTM C94/C94M states tolerances for slump and slump flow; and permits adjustments with water or admixtures to achieve the required consistency within tolerances. Requested water addition to increase slump/slump flow should not exceed the quantity established by the mix design. Excessive water addition can cause segregation, delay setting, increase the potential for cracking, and reduce strength and durability of concrete.

Air Content—Air-entrained concrete is required for concrete exposed to freezing temperatures in service. When applicable to the region, the purchaser should specify the air content of concrete or indicate the exposure anticipated for the application. Target air content depends on the size of the coarse aggregate and severity of exposure and are stated in various standards, including ASTM C94/C94M. The tolerance on air content as delivered is $\pm 1.5\%$. ASTM C94/C94M permits adjustments at the jobsite to achieve the required air content.

Requirements for Concrete—The purchaser specifies the requirements for concrete.

The preferred method for ordering concrete is by specifying **performance** requirements that can be measured by standard test methods. Concrete strength is commonly specified. Other performance characteristics, such as permeability, shrinkage, or

other mechanical and durability properties may be specified, if applicable. The concrete producer is best equipped to develop concrete mixtures for the specified performance. The strength level is generally established by the design of the structure based on the design loads or durability requirements. Specified strength of 3500 to 5000 psi (25 to 35 MPa) is typical for most concrete applications and generally ensures durable concrete for resistance to wear, abrasion, and freezing and thawing.

Alternatively, concrete can be ordered by **prescription** whereby the purchaser specifies the type of materials and imposes restrictions on the composition of the mixture. This approach does not allow the producer much flexibility and they cannot assume responsibility if concrete does not achieve the intended performance.

A mixture designation is established for each type of mixture required on a project that is included on the delivery ticket to ensure that each load delivered is the correct mixture for the location it is being placed.

Quantity of concrete—Concrete is sold by volume, in cubic yards (cubic meters), in a freshly mixed unhardened. The basis of sale is addressed in ASTM C94/C94M. The capacity of truck mixers varies between 8 to 12 cubic yards (5 to 9 m³).

Quantity of concrete ordered should be 4% to 10% more than an estimate calculated from the plan dimensions to account for contingencies. See CIP 8. Make a good estimate of concrete required for the job before placing an order and reevaluate the quantity required to complete a placement. Avoid ordering excessive concrete or small clean-up loads.

Additional Items—A variety of value-added options are available from the ready mixed concrete producer. Concrete can be designed to maintain workability for an extended time to discharge, vary setting time, reduce shrinkage, minimize corrosion of reinforcing steel, minimize temperature rise after placement, reduce the potential for chemical reactions that cause durability problems, include fibers that can impact the potential for cracking, and include a range of aesthetic options with special aggregates and integral color. If lightweight or heavy weight concrete is required, the target density should be stated. Placement methods, such as pumping with different pump line sizes need to be communicated.

Scheduling delivery—Schedule the delivery of concrete to support the construction schedule. Inform the producer of the street address, location and nature of the placement, rate of delivery based on placement methods, and estimated delivery time and placement duration. Place the order with the ready mixed concrete producer well in advance of the required delivery date. Concrete is a perishable product and the construction crew should be ready for concrete placement when the truck arrives. Notify the producer of any schedule changes or work stoppage as soon as this is known.

Ensure that the truck mixer has proper access to the placement location. A loaded concrete truck weighs about 80,000 lbs. (36,000 kg) and may not be able to maneuver on loose dirt or over residential curbs and pathways. Consider alternative conveying and placing methods when access is limited

WHAT are the Responsibilities

The responsibilities of the various parties involved in the construction process should be addressed at a pre-construction meeting, especially on a large project. Contact information and responsibilities should be documented and distributed to all concerned for reference during construction.

- The purchaser is responsible for communicating all information to the producer that is necessary to comply with a project specification and constructability requirements.
- The concrete producer is responsible for the concrete slump as specified for a period of 30 minutes after the requested time or the time the truck arrives at the site, whichever is later.
- The concrete producer is required to deliver concrete at the requested slump/slump flow and air content, within tolerances, measured at the point of discharge from the transportation unit.
- When placing procedures can potentially alter the characteristics of the fresh concrete, it is the responsibility of the purchaser to inform the producer of changes to the mixture requirements to accommodate these effects. An example is pumping concrete.
- It is the purchaser's responsibility to verify the mixture delivered, based on pre-established mixture designation, and direct the truck to the correct placement location.
- The purchaser should check and sign the delivery ticket and document any special occurrences on the ticket.
- The concrete producer cannot be responsible for the quality of concrete when any modification or additions are made to the mixture at the jobsite. These include addition of excessive water, admixtures, fibers or special products, or if the purchaser is not ready to accept the concrete in the placement location.
- Samples for strength tests used for acceptance of concrete should be obtained at the point of discharge from the transportation unit. The purchaser or their representative should ensure that facilities are available for curing test specimens at the jobsite and that standard practices are followed for subsequent curing and testing. Certified personnel should conduct the tests. Test reports should be forwarded to the producer in a timely manner for review and to allow for any adjustments needed for future loads.

References

1. ASTM Standards, ASTM Book of Standards, Volume 04.02, ASTM International, West Conshohocken, PA, www.astm.org
2. *Ready Mixed Concrete*, Gaynor, R.D. & Lobo, C.L., NRMCA Publication 186, NRMCA, Alexandria, VA, www.nrmca.org.
3. *Users Guide to ASTM C94*, Daniel, D.G. & Lobo, C.L., NRMCA Publication 2PMNL49, 2nd edition, NRMCA, Alexandria, VA, www.nrmca.org.
4. *Guide for Measuring, Mixing, Transporting and Placing Concrete*, ACI 304R, American Concrete Institute, Farmington Hills, MI, www.concrete.org

CAUTION

Fresh concrete can cause severe chemical burns to skin and eyes. Keep fresh concrete off skin. When working with concrete use rubber work-boots, gloves, protective eyeglasses, clothing and knee-boards. Do not let concrete or other cement products soak into clothing or rub against skin. Wash skin promptly after contact with fresh concrete with clean water. If fresh concrete gets into the eyes, flush immediately and repeatedly with water and consult a doctor immediately. Keep children away from freshly mixed concrete.

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