

Concrete in Practice

What, why & how?



CIP 31 - Ordering Ready Mixed Concrete

WHAT is Ready Mixed Concrete

Concrete is a mixture of cementitious materials, water, aggregate, usually sand and gravel or crushed stone. Chemical admixtures and other products are used to enhance its fresh and hardened properties.

Ready mixed concrete is that which 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, *Specification for Ready Mixed Concrete*.

There is no typical *recipe* for concrete mixtures. Concrete mixture materials and quantities vary depending on the required properties of fresh and hardened concrete. Concrete mixture composition is best developed by the concrete producer based on the requirements for specific applications as stated by the purchaser. Ready mixed concrete should have properties in its fresh 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 would depend on the anticipated loads, environmental exposure, and service conditions.

The materials for a concrete mixture are accurately weighed and mixed, either in a mixer at the concrete plant or in a concrete truck mixer. It is typically delivered in a truck mixer, which keeps the concrete uniformly mixed until it is discharged at the placement location. Concrete remains in a fluid or unhardened condition for a sufficient period of time for it to be placed and finished. Concrete normally sets or hardens within two to eight hours after mixing and continues to gain strength for months or even years if it is properly cured during the first few days.

WHY Use Ready Mixed Concrete

Concrete is a popular, economical, and versatile building material. Concrete mixtures can be customized to provide color, texture, shape, strength and other properties required for various applications. It can be delivered at varying consistency appropriate to the placement methods. It can be proportioned to achieve 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 relative to the application and established construction practices are used.

HOW to Order Ready Mixed Concrete

When placing an order for ready mixed concrete it is important to provide the basic information and to keep the requirements as simple as possible and relevant to the application. There may be different concrete mixtures needed for the different parts of a structure being constructed. The ready mixed concrete producer maintains several mixture formulations for a variety of applications and can help with selecting the right mixture for the



project. The purchaser should provide a copy of project specifications if such applies to the 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 should flow, such as the thickness of the section, space between embedments and formwork, and spacing of the reinforcing steel, if any. For most applications, nominal maximum size of coarse aggregate is 3/4 or 1 in. (19.0 or 25.0 mm).

Slump—is a measure 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 basement walls, pumped concrete or when there is congested reinforcement. ASTM C94 states tolerances for slump. Adjustments are permitted at the jobsite to achieve the slump within tolerances. Water addition requested should not be excessive so as to cause segregation or reduce the quality of concrete to less than that required. Jobsite water addition can increase air content.

Air Content—Air-entrained concrete is required for concrete exposed to freezing temperatures in service. Air-entrained concrete is the default option for exterior concrete in many regions. When non air-entrained concrete is required this should be clearly stated. Target air content depends on the size of the coarse aggregate and the typical range is 4 to 6% of the concrete volume. The tolerance on air content as delivered is $\pm 1.5\%$. The concrete supplier is permitted to make an adjustment for air content at the jobsite.

Quality required—The purchaser specifies the quality and performance requirements for concrete.

The preferred method for ordering concrete is by specifying **performance** requirements that can be measured by a standard test. Concrete strength is commonly specified. Other performance characteristics, such as permeability, shrinkage or other durability requirements may be specified when appropriate to the exposure and service conditions. The concrete producer is best equipped to develop concrete

mixtures, mix and supply concrete for the desired 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, such as resistance to wear, abrasion, and freezing and thawing cycles.

Alternatively, concrete can be ordered by **prescription** whereby the purchaser states details on the materials and quantities that make up the concrete mixture. Frequently, this approach is used when prescriptive mixture formulations have worked well in the past. This approach does not allow the producer much flexibility thereby cannot assume responsibility on the actual performance of concrete.

A mixture designation should be established for each type of mixture required on a project to ensure that concrete is placed in the correct location.

Quantity of concrete—Concrete is sold by volume, in cubic yards (cubic meters), in a freshly mixed unhardened state as discharged from the truck mixer. The basis of sale is addressed in ASTM C94. The capacity of a truck mixer is between 8 to 12 cubic yards (5 to 9 cubic meters).

Quantity of concrete ordered should be 4% to 10% more than an estimate from the plan dimensions to account for contingencies such as waste, over-excavation, spreading of forms, etc. 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 less than 4 cubic yards (2.5 cubic meters).

Additional Items—A variety of value-added options are available from the ready mixed concrete producer. Chemical admixtures can modify the setting characteristics of concrete to aid in placing and finishing during hot or cold weather. Water reducing admixtures can increase slump without adding water and reducing strength. Admixtures can be used to retain workability for longer periods if needed. Synthetic fibers can reduce the potential for plastic shrinkage cracking. Color or special aggregates can enhance aesthetic characteristics. The concrete contractor is a resource for decorative options.

Scheduling delivery—Schedule the delivery of concrete to support the construction schedule. Inform the producer of the correct address, location and nature of the pour, rate of delivery based on placement methods, and estimated delivery time and pour duration. Call and 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 immediately.

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 and 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. These responsibilities should be documented and distributed to all concerned for reference during the construction.

- The purchaser is responsible for communicating all information to the producer that is necessary to comply with a project specification and other project needs.
- 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 and air content, within tolerances, as 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 in place.
- When a job uses more than one type of concrete mixture, it is the purchaser's responsibility to verify the mixture delivered, based on pre-established designation, and direct it 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.
- When strength tests are used for acceptance of concrete, the samples should be obtained at the point of discharge from the transportation unit. The purchaser or his 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 so that deficiencies are rectified.

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, Silver Spring, MD, www.nrmca.org.
3. *Users Guide to ASTM C94*, Daniel, D.G. & Lobo, C.L., NRMCA Publication 2PMNL49, 2nd edition, NRMCA, Silver Spring, MD, 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 your 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 your skin. Wash your skin promptly after contact with fresh concrete with clean water. If fresh concrete gets into your eyes, flush immediately and repeatedly with water and consult a doctor immediately. Keep children away from dry cement powder and all freshly mixed concrete.

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