Concrete in Practice

What, why & how?

NRMCA®

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. There is a common misunderstanding that cement and concrete are one and the same. Cement is a powdered ingredient that provides the glue that binds the aggregates together in a mass called concrete.

Ready mixed concrete is that which is delivered to the customer in a freshly mixed and unhardened state. Due to the ability to customize its properties for different applications and its strength and durability to withstand a wide variety of environmental conditions, ready mixed concrete is one of the most versatile and popular building materials.

Concrete mixtures are proportioned to obtain the required properties for the application. It should have the correct consistency, or slump, to facilitate handling and placing and adequate strength and durability to withstand applied loads in the anticipated environment and service conditions. The design quantities of concrete ingredients are accurately weighed and mixed, either in a mixer at the concrete plant or in a concrete truck mixer. It is delivered in a truck mixer or agitation unit, which keeps the concrete uniformly mixed until it is discharged at the placement location. Concrete remains plastic for several hours depending on the type of mixture and conditions during placement so that there is sufficient time for it to be placed and finished. Concrete normally sets or hardens within two to twelve 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?

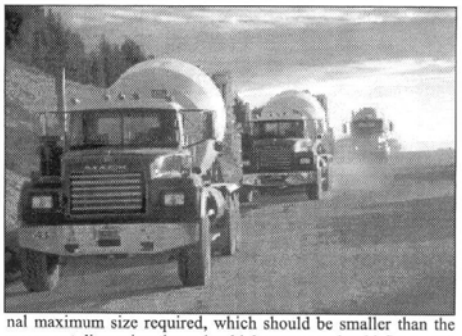
Concrete, in its freshly mixed state, is a plastic workable mixture that can be cast into virtually any desired shape. The properties of concrete can be customized for almost any application to serve in a wide variety of extreme environments. Concrete is a very economical building material that can serve its function for several years with minimum maintenance, provided the proper mixture relative to the application and established construction practices are used. A wide variety of options with color, texture and architectural detail are available to enhance the aesthetic quality of the concrete application.

HOW to Order Ready Mixed Concrete?

The key to placing an order for ready mixed concrete is to provide all the basic detailed information and to keep the requirements as simple as possible and relevant to the application. The ready mixed concrete producer has several mixture formulations for a wide variety of applications and can help with deciding the required mixture characteristics.

Some of the basic requirements to keep in mind when placing a concrete order are as follows:

Size of coarse aggregate - the important information is the nominal maximum size required, which should be smaller than the narrowest dimension through which concrete should flow, such as the thickness of the section and spacing of the reinforcing steel, if any. For most applications, nominal maximum size of coarse aggregate is ¾ or 1 inch (19.0 or 25.0 mm).



Slump - Concrete slump, a measure of its consistency, should be indicated. A stiffer mixture will have a low slump value. Typical slump range for most applications is 3 to 5 inches (75 to 100 mm). For slip-form construction a maximum slump of 2 inches (50 mm) is required, while higher slump to a maximum of 7 inches (175 mm) is typical for basement walls. The tolerance on the slump as delivered is ±1 to 1½ inch (25 to 38 mm). Addition of water at the jobsite to increase slump is permitted, provided it is not excessive enough to cause segregation and reduce strength and durability.

Entrained air - Air entrained concrete should be used if concrete will be exposed to freezing temperatures in service, or even during construction. In many locations air-entrained concrete is the default option. When non air-entrained concrete is required this should be clearly stated at the time of ordering. 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 ±1.5%. The concrete supplier is permitted to make an adjustment for air content at the jobsite if, when tested it is lower than the required amount.

Quality level required - The purchaser specifies the concrete quality, in terms of its properties or composition.

The preferred method for ordering concrete is by specifying performance requirements, which is generally the concrete strength. Other performance characteristics, such as permeability, shrinkage or various durability requirements, may be specified when required. The producer should be made aware of anticipated exposure and service conditions of the structure. The concrete producer is best equipped to proportion, mix and furnish concrete for the desired performance. The strength level is generally dictated by the design of the structure to withstand anticipated loads during construction and in service. A minimum strength of 3500

to 4000 psi (25 to 28 MPa) may ensure durable concrete, such as resistance to wear, abrasion, and freezing and thawing cycles.

Another option is to order concrete by specifying **prescriptive** requirements. The purchaser specifies limits on the quantities and types of ingredients in the mixture. In this case the purchaser should generally accept responsibility for concrete strength and performance. The prescriptive limits may indicate minimum cement content, maximum water-cement ratio, and limits on the quantities of pozzolans, slag or admixtures. Frequently, this approach is used when a particular prescriptive mixture formulation has worked well in the past. This approach does not allow the producer much flexibility on the economy of the mixture or to accommodate changes in material sources or characteristics that may affect concrete's performance.

Specifying performance and prescriptive requirements is discouraged as the performance requirements may conflict with the prescriptive limits.

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 delivered volume, or yield, is calculated from the measured concrete density or unit weight. One cubic yard of concrete weighs about 4000 lb. (2 short tons). One cubic meter (approximately 1.3 cubic yards) weighs about 2400 kg. The typical capacity of a truck mixer is 8 to 12 cubic yards (5 to 9 cubic meters).

Order about 4% to 10% more concrete than is estimated from a volumetric calculation of the plan dimensions. This will account for waste or spillage, over-excavation, spreading of forms, loss of entrained air during placement, settlement of a wet mixture, truck mixer holdback and change in volume - hardened concrete volume is 1% to 2% less than that of the fresh concrete. Reevaluate the needs during placement and communicate any changes to the concrete supplier.

Disposal of returned concrete has environmental and economical implications to the ready mixed concrete producer. Make a good estimate of concrete required for the job before placing an order. Avoid ordering 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 accelerate or retard the setting characteristics of concrete to aid in placing and finishing during hot or cold weather. Water reducing admixtures are used to increase concrete slump without adding water to the concrete. Synthetic fibers can reduce the potential for plastic shrinkage cracking. Using color or special aggregates can enhance aesthetic characteristics. The concrete contractor can also be a resource for innovative finishes and textures to concrete.

Scheduling delivery - Schedule the delivery of concrete to accommodate the construction schedule. Inform the producer of the correct address, location and nature of the pour, and an estimated delivery time. Call 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. The concrete truck weighs in excess of 60,000 lbs. (27,000 kg) and may not be able to maneuver on loose dirt and residential curbs and pathways.

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 job. These responsibilities should be documented and distributed to all concerned for reference during the construction. Some items are discussed below.

- 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 placement site, whichever is later.
- The concrete producer is required to deliver concrete at the requested slump and air content, within the accepted tolerances addressed above, 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 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 truck has to wait for an extended period before discharging the concrete.
- 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 proper facilities are available for curing the 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 to ensure that deficiencies are rectified.

References

1. ASTM C 94, *Standard Specification for Ready Mixed Concrete*, Vol. 04.02, American Society for Testing and Materials, West Conshohocken, PA.
2. *Ready Mixed Concrete*, Richard D. Gaynor, NRMCA Publication 186, NRMCA, Silver Spring, MD.
3. *Guide for Measuring, Mixing, Transporting and Placing Concrete*, ACI 304R, American Concrete Institute, Farmington Hills, MI

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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