SRT 153 Building Materials Science
Concrete Report
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Aim

The aim of this report is to outline concrete manufacturing processes, important practices within the concrete industry and standards and testing when using concrete in construction. The report follows a recent field trip to a concrete batching plant and to a testing plant in Geelong.

Concrete composition and manufacturing processes

The proportions of cement, aggregate, water and admixtures (if required), are important in making high quality and inexpensive concrete. Concrete is made up of about 65% - 80% aggregate and the rest is made up of water and cement using the water cement ratio which can be calculated by the formula W/C = water amount /cement weight, i.e. 20 L/ 40 kg = 0.5 The lower the ratio, the stronger the concrete. For example, the water cement ratios for 35 MPa concrete is 0.5; for 20 MPa concrete it is 0.75; and for 10 MPa concrete it is 1.0. Hence, the lowest water cement ratio has the highest MPa. (Concrete Basics, 2004)

Aggregates come in different textures and sizes but for standard concrete the average aggregate size should be 20 mm (metromix.com.au). Coarse aggregates consist of crushed rock and gravel. Sand is an example of a fine aggregate. Aggregates should be free of all dirt and clay and should not consist of soft stones that crumble easily, such as sandstone, as these weaken the concrete. Aggregates need to be strong and durable stones that withstand the elements, for example, granite. Aggregate shapes are either angular or rounded. Angular aggregates create a less workable but stronger concrete as they bond together much better than rounded aggregates. Rounded aggregates create a more workable but weaker concrete (Concrete Basics, 2004).

The curing process takes place just after finishing the concrete. Curing makes the concrete less likely to crack and makes the concrete more durable. The main process involved in curing is “to cover the concrete so it stays moist” (Concrete Basics, 2004 p. 28). Curing must be done using a fine spray of water over the concrete, as it does not harden well if it dries quickly. This process should take at least 3 days, but the longer the curing process, the stronger the concrete. The most common cement used in Australia is Portland cement. It contains Tri-calcium Silicate, Di-calcium Silicate, Tri-calcium Aluminate, Tetra-calcium Alumino-ferrite, Gypsum and other. The proportions of each element are shown in Figure 1. There are six major types of cement in Australia, as shown in Table 1.

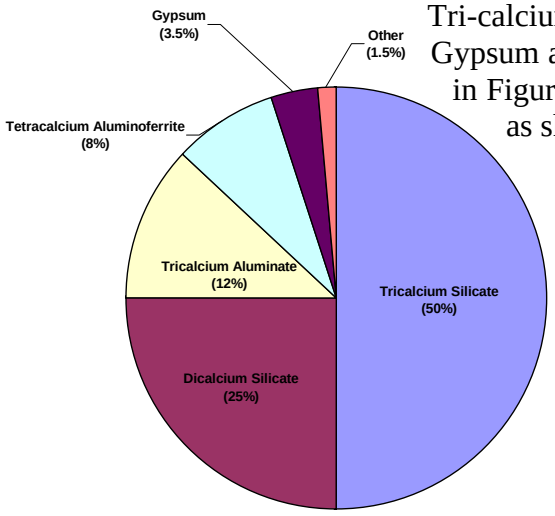

Figure 1: Portland Cement Components

Type	Description
GP	General purpose Portland cement
GB	General purpose Blended cement
HE	High Early Strength cement
LH	Low Heat cement
SR	Sulphate Resisting cement
SL	Shrinkage Limited cement

Table 1: Types of Cement

Concrete industry practices

Concrete is transported from the batching plant to the work site in large concrete mixing trucks. The batching plant has an automated system which measures the precise percentages of components needed to create the concrete for the site. The concrete is mixed in the trucks while in transit, but concrete inside the truck's chamber tends to become sticky and can start to dry out overtime. Retardant admixtures can be added to stop drying out. It is important therefore to choose a concrete supplier that is within a close distance to the site to avoid pre-mixed concrete drying out or having to use retardants.

Concrete standards and tests in construction

All concrete has to be made and tested under the strict guidelines of The Australian Concrete Standards Code. This report will focus on two standard tests; the slump test, which tests the workability of concrete, and the compression test, which tests the compressive strength in MPa. The slump test uses a standard slump cone measuring 100 mm for the top diameter, 200 mm for the bottom diameter and 300 mm high. There are eight steps in the slump test, (i) cleaning the cone, placing it on a slump plate which should be hard and non-absorbent and dampening both with water; (ii) collecting a sample of plastic state concrete; (iii) fastening the slump cone to the ground or table and filling it to about 1/3; compacting it using a bullet tipped rod (rodding) by poking the rod down in to the concrete 25 times; (iv) filling the cone by another 1/3 and rodding the new layer 25 times; (v) filling the cone once more until it overflows and rodding the new layer 25 times; (vi) levelling the surface with the rod, holding the cone down via the handles and unfastening it; (vii) lifting the cone straight up; (viii) turning the cone over, placing the rod level on the cone and measuring how far the concrete as "slumped", as shown in Figure 2. (Concrete Basics, 2004)

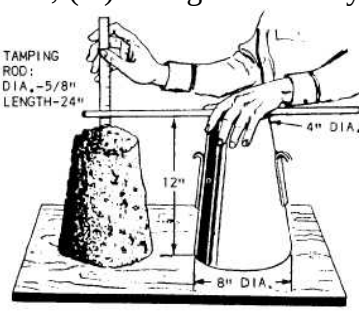

Figure 2. Final step in slump test (tpub.com, 2008).

For the compressive strength test, the concrete is placed into a cylinder measuring 100 mm in diameter and 200 mm high or 150 mm in diameter and 300 mm high. There are only seven steps involved; (i) cleaning the cylinder and coating the inside lightly with oil and levelling the plate; (ii) collecting the sample; (iii) filling the cylinder about ½ way and rodding the sample 25 times; (iv) filling the cylinder until it overflows and rodding the new layer 25 times; (v) levelling the top surface with the rod and cleaning the area; (vi) capping and tagging the cylinder and putting it in a cool dry place for 24 hours; (vii) the last step is removing the dry concrete from the cylinder and sending it to a laboratory were it is cured, crushed and tested for its MPa at failure recorded (Concrete Basics, 2004).

Conclusion

This report has discussed concrete composition and manufacturing processes, concrete industry practices regarding the delivery of ready-mix concrete and concrete standards and testing. If concrete is mixed correctly, it can be easily workable and extremely strong. Concrete has a high amount of compressive strength up to around 40 MPa and, due to the curing process, it continues to get stronger over time. Concrete is an ideal material for structural components in the building industry.

Reference list

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