BEST PRACTICE GUIDELINES FOR COMPRESSIVE STRENGTH TESTING OF CONCRETE TESTED ON-SITE

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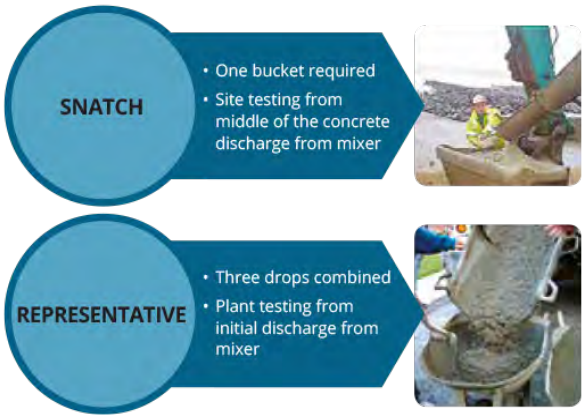
This leaflet addresses compressive strength testing of concrete that is particularly relevant for independent testing companies who sample site concrete.

SAMPLING OF CONCRETE

The type of sampling done on site concrete must be stated, being either representative or snatch and done in accordance with NZS 3112: Part 1, Section 3. A representative sample is a composite of three sub-samples that are mixed together whereas a snatch sample is a single sample taken from the point of discharge. Snatch sampling is acceptable on site but should be taken from the middle of the discharge.

SAMPLING TYPE



SLUMP TESTING OF CONCRETE

It is recommended that a slump test is done before making cylinder specimens as stated in NZS 3104, Clause 2.15.1.1. This ensures concrete was at a suitable consistence level to be adequately compacted on site using mechanical methods in accordance with NZS 3112 Part 1. Fresh concrete sampled on site should not be transported back to the laboratory due to segregation and stiffening of the material in transport.

NUMBER OF TEST SPECIMENS

When assessing the compressive strength of concrete, three test cylinders are required for each test from the same sample of concrete. This may be reduced to two specimens when analysis of strength results shows that the within test coefficient of variation is less than 4% as defined by NZS 3104 and NZS 3112 Part 2. This requirement is to ensure that the mean strength is reliable since confidence in the result will be reduced if testing is not able to produce consistent strengths between test specimens.

CURING OF CONCRETE

Site testing of concrete requires sampling, cylinder making and storage to be done at this location until the strength of concrete is sufficient to allow transportation back to the laboratory. NZS 3112 Part 2 states that cylinders should be left undisturbed for 16 hours to 80 hours. Concrete stored on site needs to be suitably protected such that specimens remain at a temperature between 10–26 °C. These temperature limits are given since prolonged storage at low temperatures will produce lower than normal 7-day strengths, while high temperature storage can reduce 28-day strength.

MOISTURE CONDITION

Concrete must be cured at a temperature of 19-23 °C in a saturated condition until testing for compressive strength at 7 or 28 days. Test cylinders should be tested in the saturated surface dry condition and should not be allowed to dry out excessively. Typically test cylinders are tested within two hours of being taken out of the curing tank unless plaster capping is applied. Concrete must be cured at a temperature of 19-23 °C in a saturated condition until testing for compressive strength at 7 or 28 days.

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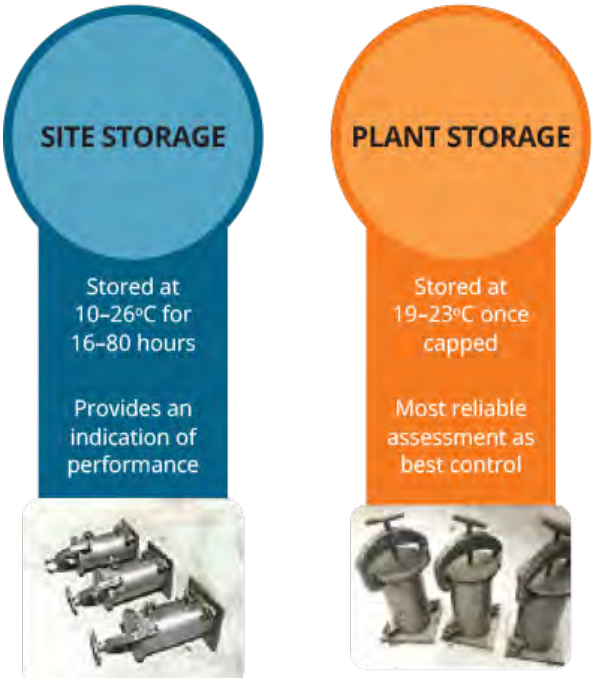
STORAGE OPTIONS



DIMENSION AND WEIGHT

The dimensions and weight of test cylinders are measured in accordance with NZS 3112 Part 2. This is done for several reasons; to confirm dimensions are within tolerance, to calculate cross-section for strength and calculate volume used with the weight to assess hardened density. Poor practice such as inadequate compaction and curing will be seen not just in strength but also in the hardened density.

END TOLERANCES

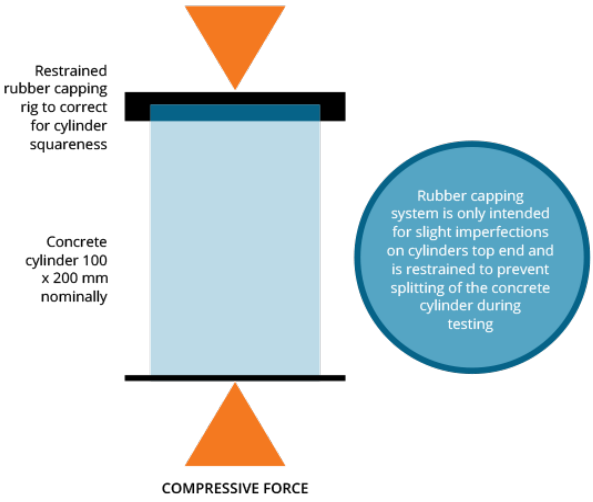
The ends of test specimens need to be checked for flatness, squareness and defects as these will affect the strength tested if outside the stated tolerances in NZS 3112 Part 2. Greater allowance for top ends being out of square and level is allowed when using the restrained rubber capping device, but this is only intended for use on the top of the cylinder. Should either end be out of the specified tolerance given in NZS 3112 Part 2 then hard plaster capping or grinding is required. Rubber caps are supplied at a shore hardness of 50-65 for normal concrete up to 50 MPa and 75 for high strength concrete above 50 MPa.

CAPPING OF ENDS

Several methods of capping are possible for test cylinders that are summarised as follows:

- Restrained rubber that is permitted using 105 mm diameter rigs for 100 mm cylinders is used on one end and concrete strengths do not exceed 80 MPa.
- Sulphur capping is permitted provided cap is at least one hour old and strength exceeds 35 MPa for concrete less than 50 MPa and two hours old for higher strength concrete.
- Gypsum plaster is permitted provided cap is at least an hour old and plaster mixture is at least 35 MPa and concrete strength is less than 50 MPa.

CAPPING TEST CYLINDERS



TESTING MACHINE

Testing machines for compressive strength need to comply with NZS 3112 Part 2 Section 6 with the following key requirements:

- Machine is calibrated annually to ensure reliability in compressive forces being measured.
- Load pacer or automatic system is used to ensure constant load rate between 10-20 MPa/min.
- The lower platen has a centring device to ensure test specimens are uniformly loaded.
- The upper platen shall be spherically seated to allow rotation of the bearing surface.
- Loading is centrally distributed through the inscribed centre of the steel platens.

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TESTING PROCEDURE

The test procedure shall be carried out in accordance with NZS 3112 Part 2 Section 6:

- Place test specimen centrally in the machine.
- Ensure that the hydraulically activated platen is floating and scale is zeroed.
- Bring the upper platen and test specimen together until a uniform bearing is obtained.
- Apply force with shock and increase continuously at the specified load rate until crushing occurs.
- Record the maximum compressive force applied and record this value.
- Examine crushed test specimen and note whether normal or shear failure and any abnormality.

TEST REPORTING

The following information should be recorded for each test specimen and kept as a laboratory record:

- Identification of test specimen with date of test and age of specimen.
- Any unusual defects or notes about the specimen before testing.
- Dimensions and weight of test specimen as well as any end defects or out of tolerance.
- Maximum force applied and calculated density and compressive strength.
- Mode of failure of test specimen and any special notes of abnormalities.
- Grade of concrete tested to check whether test specimen has failed.

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