

Special Concrete Guidelines

Kerb and Channel Machine Placed Concrete



THE NEW ZEALAND
READY MIXED
CONCRETE
ASSOCIATION INC.

Prepared by the Technical Committee of the NZRMCA

Introduction

Concrete produced for kerb and channel machine placing is a special concrete requiring different mix design, mix adjustment on site and different testing procedures to Normal wet cast operations.

Wet cast operations follow the standard procedures for Normal Concrete (N) of supply and testing contained in NZS 3109 Concrete Construction and NZS 3104 Concrete Production.

The semi dry cast extrusion processes of kerbing/channel machines defines the concrete as Special Concrete (S).

In accordance with the provisions of NZS 3109 it is necessary to specify the performance requirements of the concrete as well as the method of testing to be employed. In this case some of the tests included in NZS 3112 Concrete Testing are not appropriate.

There is no NZ Standard written specifically for machine placed kerb and channel operations but the Australian Standard AS 2876 Concrete Kerbs and Channels – Manually or Machine Placed covers this application. The recommendations included in this leaflet are therefore influenced by the requirements of AS 2876.

NZS 4404 Land Subdivision and Development Engineering contains significant data on the size, position and type of kerb and channel. However it does not specify the strength or performance characteristics of the concrete to be supplied. Most Local Authorities do specify their own requirements particularly with regard to strength. The strength parameter given for the supply of the concrete is related to Normal concrete supplied for wet cast technique where placing and testing follow the normal rules of NZS 3104/3109/3112.

This leaflet is produced to assist in the specification and testing of semi dry concrete used in machine placing.

Specifications

The Special Concrete supply can be specified in a number of ways:

- (i) Minimum cement content and limiting workability (e.g. no slump).
- (ii) Specified concrete strength and limiting workability.

In the first case the method of quality assurance is by reference to batching records and if in terms of perceived failure of the kerb and channel, hardened concrete samples can be taken and cement content determined by analysis. These procedures are referenced in NZS 3104 Part 3 with an accuracy limitation of 20 kg/m³ cement i.e. the cement content must not be less than specification by 20 kg/m³ otherwise the concrete can be rejected.

Recommended specifications for this approach are:

Mix A: 280 kg/m³ Cement Content for Main Roads, etc.

Mix B: 260 kg/m³ Cement Content for Distributor Collector Roads.

Mix C: 240 kg/m³ Cement Content for Residential Roads, Cul de Sacs, etc.

* Definitions for traffic are from NZS 4404.

All concrete supplied as No Slump concrete when tested in accordance with NZS 3112 Part 2.

There will be strength variations resulting from different aggregates used in different plants around the country. NZRMCA member plants will have established the mix performance criteria using these cement contents, i.e. Strength at 28 days and the density of the concrete.

A customer can either use the A, B or C method of specification which is recommended or use a specified concrete strength approach.

If specified concrete compression strength is used for direct evaluation for quality assurance purposes, then it is necessary to provide special test procedures.

The problem is that with semi dry concrete the simple techniques for achieving maximum compaction of the specimen as required by NZS 3112 for wet concrete are not suitable. Full compaction can only be achieved by special techniques, e.g. vibrating tables, vibrating hammers etc. These techniques are not conveniently available for evaluating the concrete at site.

The ready mixed concrete supplier will be able to supply test evidence that the mix design for **fully compacted** concrete will meet a specified compressive strength of the concrete supplied.

Difficulties arise for this method when evaluating an assurance check or a perceived failure of hardened concrete kerb and channel. The taking of concrete core specimens from kerb and channel profiles is extremely difficult because of anchorage of the coring machines. Evidence shows that cores are damaged during the process and low compressive results are recorded.

This issue is dealt with in the Australian Standard 2876. The requirement is that the cores taken are measured for **density** not strength in accordance with NZS 3112 Part 3 and compared with the density of the supplied concrete. If the density of the concrete is less than 95%, the designer has the option to reject the concrete. However, evaluations carried out on kerbing products in New Zealand indicate that a value of 92.5% compaction minimum provides satisfactory performance of the kerbing.

The cement content can also be checked to establish that the concrete supplied was the kerb/channel verified mix design.

Delivery of Semi Dry Concrete and Adjustment of Workability for Machine Placing

The kerbing contractor will increase the water content to suit characteristics of the extrusion machine. This is different practice to the supply of wet concrete where the responsibility for workability adjustment is with the ready mixed concrete supplier and controlled by NZS 3104 to a maximum of 10 litres/m³.

There are practical limits of water addition imposed on the kerbing contractor in terms of workability. If too much water is added the machine will not be able to extrude and hold shape, i.e. there is a practical self-limiting control.

With semi dry concrete the addition of water at this stage up to when it becomes a wet mix, will result in **increases** in strength coming from better compaction. When water is added to wet concrete there will be only a small improvement in compaction but the water/cement ratio relationship will fully apply, i.e. more water, less strength.

The addition of water to achieve an optimum machine compaction is a permitted activity in AS 2876.

Protection of Kerb and Channel

After the initial extraction of profile, whether or not a finishing mortar coat is applied, the quality and performance of the concrete is significantly influenced by lack of protection, particularly from sun and wind.

Protection by covering, mist spraying, curing membranes etc, all provide significant improvements in the durability performance. Durability can be improved by up to 15 times if the proper curing regimes are used.

Shrinkage Control

All concrete shrinks during the drying process which will take place over several weeks. Unreinforced kerb and channel sections will often form a shrinkage crack at 2 to 3 metres if no control joints are introduced.

In some cases, the formation of the crack is considered to be of no visual consequence. When visual aspects are considered important, then the kerb and channel should have control joints provided either by a knife-edge cutting while the concrete is still plastic or by sawing to 50% of the full section area. Sawing would be done the next day.

The modular spacing of the joints needs to consider the paving adjoining the kerb so that kerb joints and any concrete pavement joints will align. Failure to align the joints often means that the concrete paving will develop an unwanted crack across the pavement.

The recommended spacing of shrinkage control joints should not be greater than 5 m. Where the kerb intersects into crossovers or undergoes a sharp change in direction the

first shrinkage control should be positioned at this point or no further than 2 m from the point.

Summary

The purpose of the leaflet is to explain to the specifier/customer that the performance of semi dry concretes is more heavily influenced by the degree of compaction than water additions that traditionally significantly influence wet concrete properties.

The rules are:

- (1) Semi dry concrete (no slump) to a specific mix design A, B, or C can be supplied to suit the application.**
- (2) The Kerbing Contractor adds water to the mix to adjust its compactability for the kerbing machine being used.**
- (3) The quality assurance of the concrete supply can be demonstrated by the batch records and basic strength data by the ready mixed concrete supplier.**
- (4) If quality assurance of the finished kerb is required, it can be identified by coring the kerb to establish the density of the concrete. The density should be compared with the records of the ready mixed concrete supplier and should be at least 92.5% of the basic density. The core could also be submitted for a cement content test.**

References

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