

**THE REVISED NZS 3104 SPECIFICATION FOR CONCRETE PRODUCTION AND THE
CONCRETE NZ PLANT AUDIT SCHEME**

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SUMMARY

This paper looks at two recent and important developments in the New Zealand concrete industry – the revised NZS 3104 – Specification for concrete production and the refreshed Plant Audit Scheme.

The revised NZS 3104 – Specification for concrete production, was published in April 2021. The paper will provide an overview of the key changes in the revised Standard to ensure structural engineers are aware of the requirements and changes.

The Plant Audit Scheme has been a pillar of the New Zealand concrete industry since the 1960s providing the building industry with confidence that concrete is reliably produced in accordance with relevant Standards. In recent years, the former New Zealand Ready Mixed Concrete Association (NZRMCA) Plant Audit Scheme has transitioned to become the Concrete NZ Plant Audit Scheme. With this transition there has been a need to ensure that industry is aware of the Plant Audit Scheme and the benefits it brings.

NZS 3104 – SPECIFICATION FOR CONCRETE PRODUCTION

NZS 3104 has been revised in the past two and a half years – the revision project commenced in the second half of 2018 and the revised Standard was published in April 2021 superseding the previous 2003 version. Concrete NZ funded the review and performed the project management required for the revision process, to complement Standards NZ roles of facilitating the consultation and publication process.

NZS 3104 prescribes the minimum requirements for the production of fresh concrete. Compliance with NZS 3104 ensures compliance with the requirements for the supply of fresh concrete given in NZS 3109, which in turn meets the materials requirements of the Concrete structures standard NZS 3101 and therefore provides a means of demonstrating compliance with the New Zealand Building Code.

A key driver to revise this Standard, on top of ensuring concrete industry Standards maintain currency, was to address sustainability and provide increased incentives for concrete batching plants that demonstrate rigorous production control.

The committee consisted of representatives from the following organisations:

- Building Research Association of New Zealand (BRANZ)
- Concrete NZ
- Concrete NZ – Learned Society
- Concrete NZ – Precast Sector group
- Concrete NZ – Readymix Sector Group
- Engineering NZ
- Structural Engineering Society of New Zealand (SESOC)

The committee chair was Dr James Mackechnie, with SESOC represented by Sue Freitag.

Overview of NZS 3104:2021 Specification for concrete production

The fundamental structure of the document remains unchanged from the previous version. The key sections of the Standard are as follows:

1. General – covering scope, interpretation, definitions, abbreviations.
2. Provisions for ready mixed concrete – sets out the requirements for the production of ready mixed concrete at batching plants. The requirements of this section cover:
 - a. Personnel – the requirements and responsibilities of the Plant Engineer and Plant Supervisor.
 - b. Material requirements.
 - c. Batching plant requirements including storage, measuring and weighing
 - d. Concrete mixing and transportation.
 - e. Responsibility for mix design for normal concrete and special concrete (any concrete defined with performance criteria other than strength, such as shrinkage, tensile strength; or strength greater than 50MPa, is considered 'special concrete').
 - f. Variability control.
 - g. Control tests of concrete such as – slump, yield, air content, and cylinder strength tests.
 - h. Quality audits – setting out requirements that a batching plant can demonstrate compliance with NZS 3104 by holding a current Certificate of Audit.
3. Provisions for prescribed mix concrete – provides material proportions for concrete mixes for concrete strength ranging from 10MPa to 25MPa.
4. Concrete Mixers – sets out the requirements for the performance of concrete mixers covering stationary, truck mixers and continuous mixers.

The principal changes in the new version of NZS 3104 include:

- Daily moisture content measurements of fine aggregates – to better control the total water content of fresh concrete and improve the reliability of yield achieved.
- Increased frequency of yield testing of concrete – this testing can identify significant changes in fresh density consistent with under or over cement content in the mix.
- Mandatory requirement for 7-day strength testing – 7-day strength testing was generally already performed by most batching plants (which can assist with earlier detection of non-compliant concrete so intervention measures can be triggered sooner) but is now compulsory for all batching plants encouraging consistent quality control processes.
- Incentives for concrete plants with excellent production control – can help reduce the amount of cement if rigorous production control is demonstrated.
- Longer-term strength testing allowance when using Supplementary Cementitious Concrete (SCM) concrete – acknowledging the expected increase in the use of SCMs to help reduce the emissions from the manufacturing process of concrete – this will be an ever-increasing expectation as clients and designers will want their projects to demonstrate reduced emissions – therefore making concrete with increasing amounts of SCMs with different properties will need to be facilitated.
- Editing to improve clarity of the previous version of the Standard.

It is recommended that consultants review their existing specifications to ensure the most recent version of NZS 3104:2021 is referenced. The consultant specification on concrete production then also typically points to the Plant Audit Scheme which is the next topic of this paper.

THE CONCRETE NZ PLANT AUDIT SCHEME

The Concrete NZ Plant Audit Scheme, formerly the New Zealand Ready Mixed Concrete Association (NZRMCA) Plant Audit Scheme, has existed for nearly 60 years – the protocols for a concrete quality control scheme, which included a monitoring requirement to see if plants were adhering to the Scheme, were developed in May 1963 (Barnard, 2013). With the consolidation of the New Zealand concrete industry associations in 2017 the former NZRMCA Plant Audit Scheme transitioned to become the Concrete NZ Plant Audit Scheme.

The Plant Audit Scheme provides an independent and rigorous audit of the quality systems in place at a ready mixed concrete plant which in turn provide suppliers, designers and clients confidence that participating audited plants, that hold a Certificate of Audit, are reliably supplying concrete in accordance with the requirements of NZS 3104.

There are currently nearly 200 audited batching plants across New Zealand. The location of the current audited plants can be found at <https://rmcplantaudit.org.nz/audited-plants/>

Plant Audit Scheme requirements and operations

Further to complying with NZS 3104 Specification for concrete production each batching plant must have:

- a Plant Engineer who is either a Chartered Professional Engineer (CPEng), a Chartered Member of Engineering New Zealand (CMEngNZ) or a Registered Engineering Associate (REA),
- an appropriately qualified employee who carries out concrete testing; and
- properly maintained records of concrete productions and testing.

Experienced and qualified auditing engineers, appointed by the Plant Audit Committee, perform the audits of the participating plants (refer to Figure 1. Organisational structure of the Plant Audit Scheme).

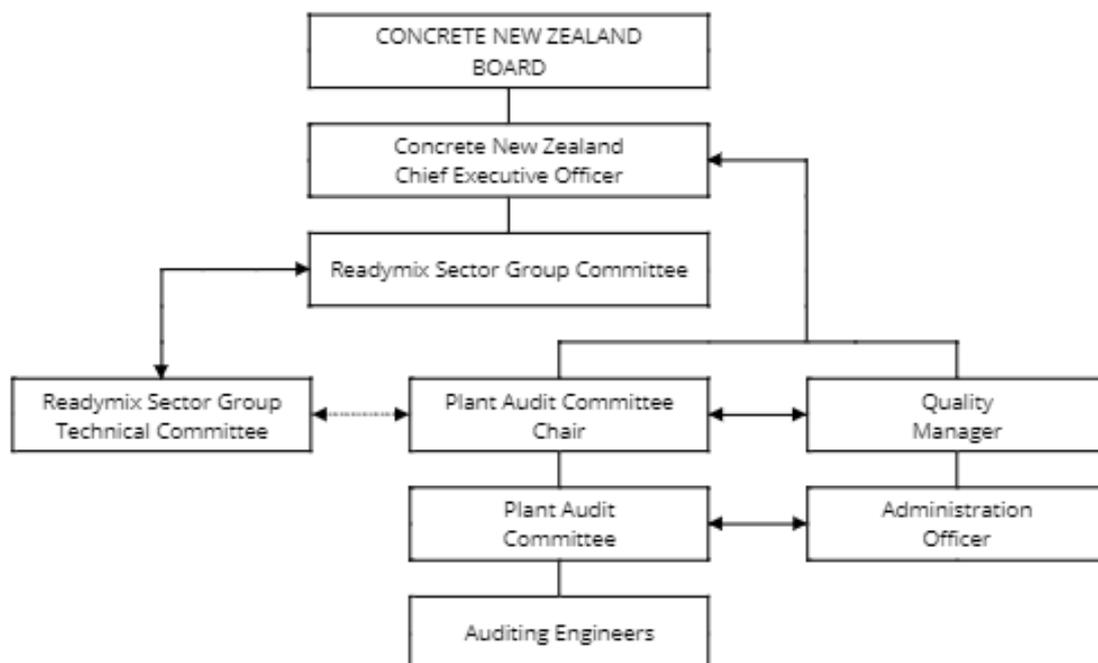


Figure 1. Organisational structure of the Plant Audit Scheme

The Plant Audit Committee is comprised of Professional Engineers and Registered Engineering Associates who have extensive experience in the concrete production industry. The Committee has two externally appointed members. One member is appointed by Engineering NZ and the other by the Concrete NZ Learned Society. The current chair of the Plant Audit Committee is Dr James Mackechnie.

The auditing engineers review the submitted test records and undertake site visits of the batching plants on a two-year cycle (refer to Figure 2. Operation of the Plant Audit Scheme). For the purposes of operating the Plant Audit Scheme New Zealand is divided into four zones.

All batching plants participating in the scheme report their performance and testing data to the Committee annually. Among the performance criteria audited and reported on are:

- Mean concrete strengths and coefficients of variation
- Aggregate quality by testing and monitoring
- Weigh scale calibration and accuracy
- Mixer efficiency tests
- Laboratory equipment calibration
- Production and testing record keeping
- Technician training
- Plant operator performance
- Effectiveness of plant engineer's monitoring of quality controls

In addition to the above criteria, the frequency of testing within each quarter year must be submitted to the Plant Audit Committee. Failure to maintain testing requirements can result in the withdrawal of an Audit Certificate.

All participating batching plants will also have an on-site audit every second year to verify that the information reported regularly by the Plant Engineer accurately represents the performance of the plant. It provides an opportunity to check that personnel, equipment and systems at a batching plant are meeting the requirements of NZS 3104. Random site audits may also be carried out without warning at any time.

The Plant Audit Committee meet quarterly to assess the audit reports for a specific zone. They will then determine if the plants are acceptable for issuing a Certificate of Audits or if they need to respond to identified non-conformances prior to the issue of a Certificate of Audit (refer to Figure 3. Example Concrete NZ Certificate of Audit Compliance). The Certificate includes the maximum MPa (up to 50 MPa) that a batching plant can supply. A Certificate of Audit is typically issued for a 12-month duration in which time it must be revalidated. An interim certificate of audit, valid for 3 months may also be issued to allow a plant to rectify minor deficiencies.

Any new batching plants assessed for the first time, after receipt of a plant report, will be subject to a site inspection of the plant. If the plant meets the requirements of the Plant Audit Scheme, an interim Certificate of Audit will be issued with a three-month duration. In this three-month period the batching plant will be reassessed and if it continues to meet the requirements it will be issued a Certificate of Audit with a maximum twelve-month duration.

PLANT AUDIT SCHEME ZONE CYCLE

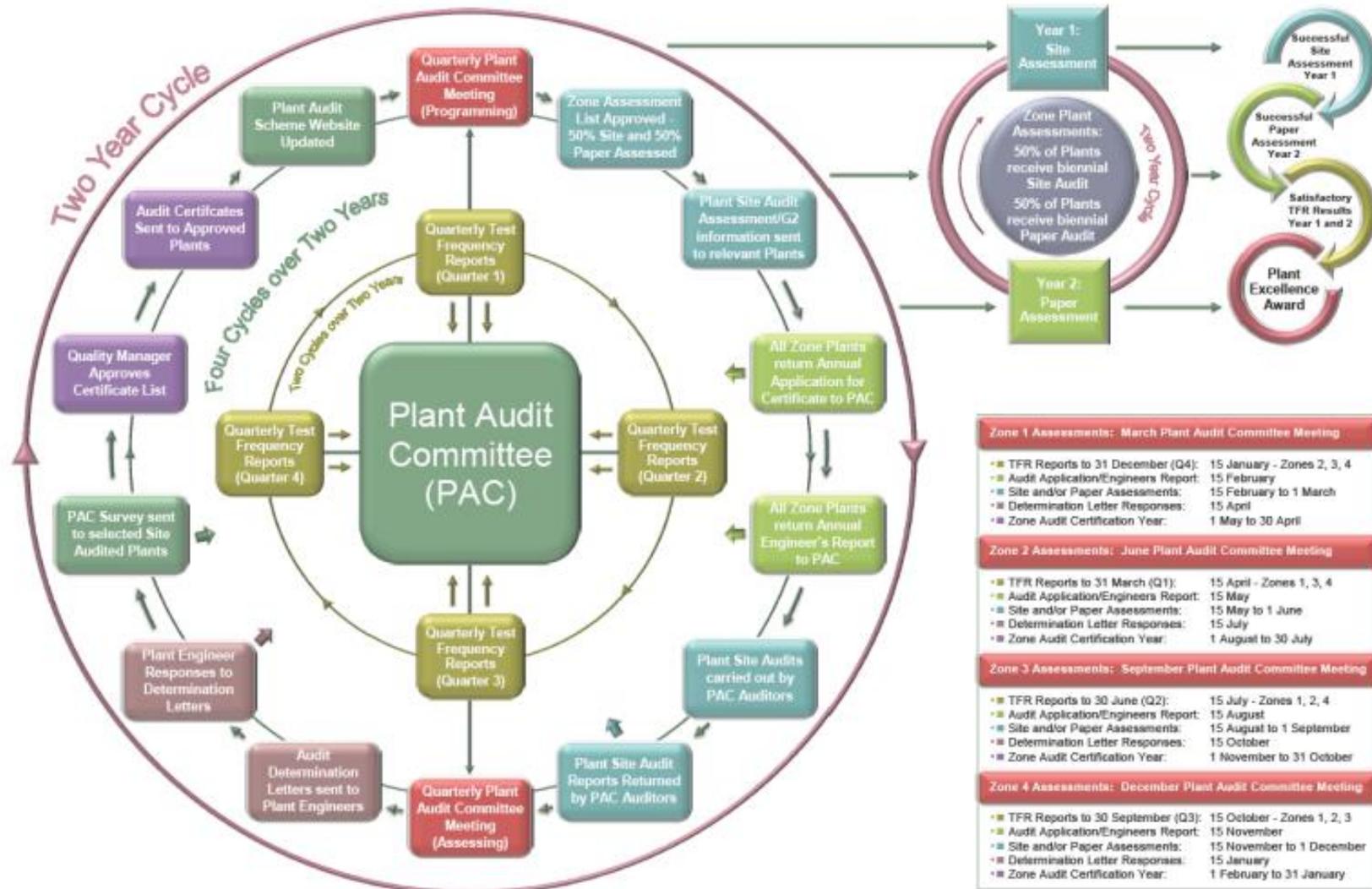


Figure 2. Operation of the Plant Audit Scheme



Figure 3. Example Concrete NZ Plant Audit Scheme Certificate of Audit

It should be noted that it is not mandatory for a concrete batching plant to hold a Certificate of Audit. It is therefore important to be aware that when concrete, specified to meet the requirements of NZS 3104, is supplied from an un-audited plant, the purchaser and/or the designer is responsible for the implementation of the audit process and/or project testing to ensure the concrete complies with New Zealand Building Code.

The management of the Concrete NZ Plant Audit Scheme is certified to ISO 9001 and undergoes an external audit by BVQI (Bureau Veritas Quality International) on an annual basis to maintain its ISO 9001 certification (refer to Figure 4. Certificate confirming management of the Concrete NZ Plant Audit Scheme is certified to ISO 9001).



Figure 4. Certificate confirming the management of the Concrete NZ Plant Audit Scheme is certified to ISO 9001

Acknowledging that a new version of NZS 3104 has been published some aspects of the Plant Audit Scheme Handbook, that sets out the requirements for performing plant audits, are being updated.

More general information on the Concrete NZ Plant Audit Scheme, such as the current status of a batching plant, is available at <https://rmcplantaudit.org.nz/>.

CONCLUSIONS

NZS 3104 has been revised and published in April 2021. It contains provisions:

- that allow batching plants with excellent production control to reduce their cement content; and
- that facilitate longer term strength testing with the anticipated increased use of Supplementary Cementitious Materials (SCMs).

These new provisions will assist with the concrete industries' overarching drive to reduce emissions.

The rebranded Concrete NZ Plant Audit Scheme continues to provide independent and rigorous audits of the systems in place at a concrete batching plant, providing concrete purchasers and designers confidence that concrete produced by an audited plant meets the requirements of the NZS 3104, the New Zealand Standard for concrete production.

It is important that designers review and check that their specifications correctly reference the new revisions of NZS 3104:2021 and the Concrete NZ Plant Audit Scheme to ensure the concrete for a project meets the requirements of the New Zealand Building Code.

REFERENCES

Barnard, D. P. (2013), *Plant Audit Scheme, Where is it and where is it going?*, NZ Concrete Industry Conference 2013, Queenstown

Standards NZ (2003), *NZS 3104:2003 Specification for concrete production*, Wellington, New Zealand.

Standards NZ (2021), *NZS 3104:2021 Specification for concrete production*, Wellington, New Zealand.