PERFORMANCE SPECIFICATION GUIDELINES FOR THE SUPPLY OF READY MIXED CONCRETE IN NEW ZEALAND

DR JAMES MACKECHNIE
Concrete NZ Education, Training and Research Manager

Specifications for the supply of concrete to construction projects tend to have a combination of prescriptive and performance-based criteria. Prescriptive elements in specifications are simple to achieve but sometimes these requirements are in direct conflict with the stated Performance required for the project.

Internationally there is a movement towards performance -based specifications whereas locally some structural designers appear to favour prescriptive-based approach where recipes need to be followed or specific materials included in concrete mixes such as chemical admixtures or additives. This prescriptive approach provides less flexibility for concrete suppliers to optimise concrete mixes and may in fact be counter-productive in some cases. Using a performance-based approach to specifying concrete has many benefits but must be well managed to ensure overall structural performance and serviceability are achieved.

Prescriptive specifications are often seen as the safest option by structural engineers as they are not familiar with performance based techniques and rely on older approaches that may have worked in the past. Examples of current specifications clauses that are in direct conflict with modern principles of concrete technology include the following:

- Specifying low slump targets and tolerances that will severely reduce rate of delivery of concrete or are impossible to achieve.
- Restricting the use of chemical admixtures such as superplasticisers due to problems using these materials many years ago when the technology was being developed.
- Specifying maximum water/cement ratios in the mistaken belief that this controls shrinkage and by

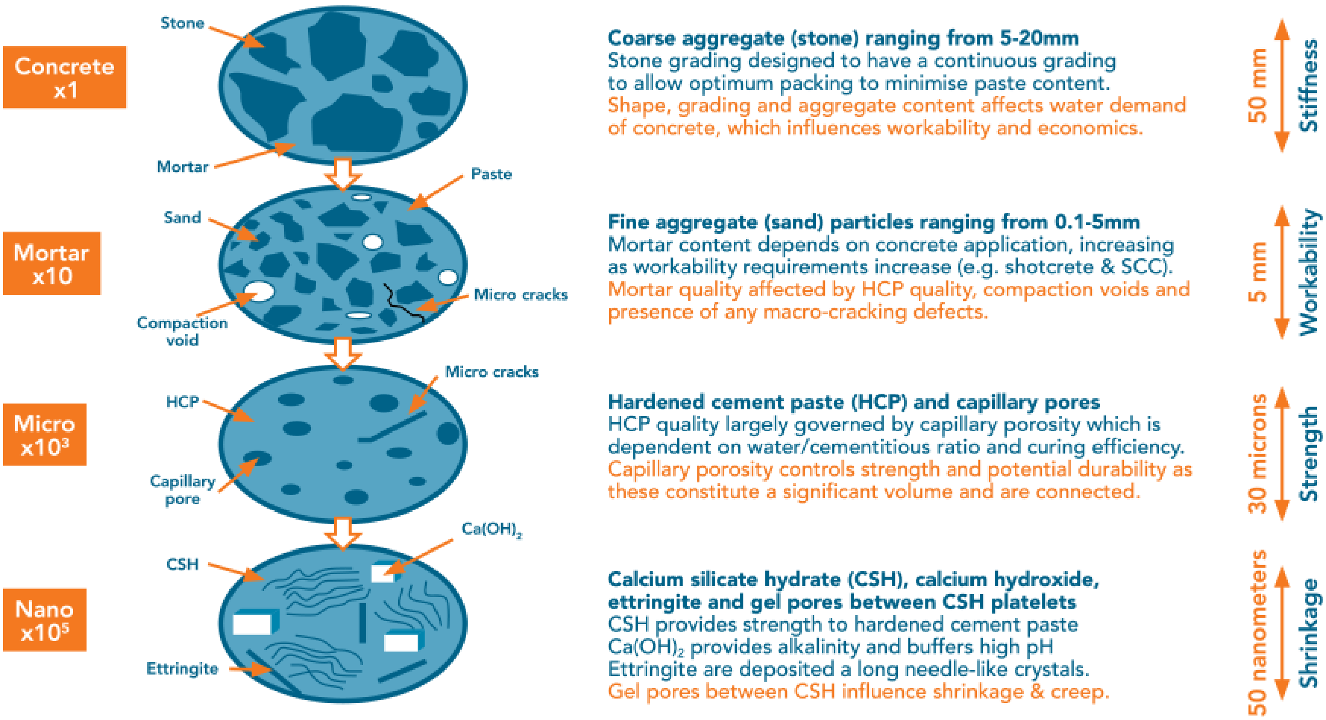

Figure 1: Microstructural model for concrete

association will reduce the risk of cracking.

- Limiting the drying shrinkage of concrete to very low values despite the structure being relatively massive such as raft slabs where limited drying is possible.

- Specifying minimum cement contents for waterproof or high durability concrete rather than considering appropriate performance requirements.

- Implementing performance-based specifications needs an understanding of the overall framework so that testing is targeted correctly, limits are achievable and there is some allowance for variability.

Performance based specifications target the required outcome and allow contractors and concrete suppliers to achieve this without prescribing materials or mix

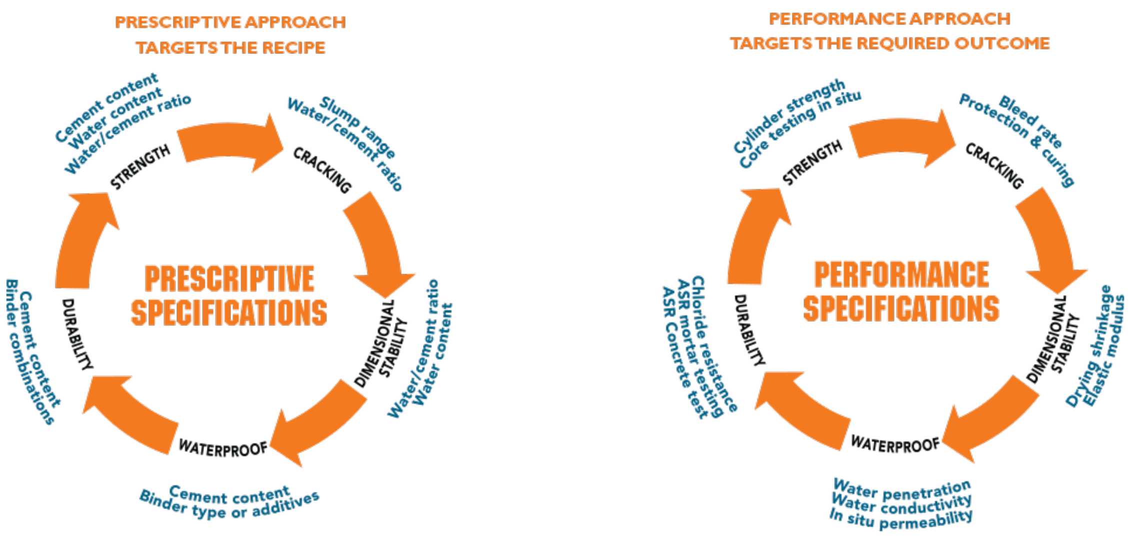

Figure 2: Prescriptive versus performance specifications

Many specifications used in construction require updating and structural engineers could do well to update their knowledge of concrete technology. Figure 1 shows a basic microstructural model of concrete, which when properly understood should help improve concrete specifications. Contractors and concrete suppliers often find the following issues when dealing with concrete specifications currently being used in New Zealand:

- Slump is not a direct measure of workability and practical slump targets need to be set to ensure placing and compaction of concrete is not compromised on site.

- When specifying a grade of concrete it is not necessary to prescribe minimum cement contents or maximum water/cement ratios as these are often in conflict with the strength used to design the structure.

- Specifying a drying shrinkage limit is only necessary for shrinkage sensitive structures such as bridge decks and toppings and should not be considered as a predictor of cracking risk.

- There are a range of durability tests that can be used to measure the resistance of the cover concrete to carbonation or chloride ingress and these need to be carefully considered in terms of speed of measurement, reliability and cost.

design details. The difference in approach is illustrated in Figure 2 and it should be stressed that many projects require only limited performance targets such as strength. Using a hybrid specification with some prescriptive and some performance limits is also widely done and is not problematic if prescriptive requirements are practical.

Many larger infrastructure projects have defined performance requirements, the achievement of which cannot be assumed, but needs to form part of the quality assurance of the contract. Any framework for establishing performance criteria needs to consider the following:

- Robust quality control tests that can be routinely carried out by laboratory technicians and have both reliability and repeatability as found in cylinder strength testing.

- Service life model that is able to relate service performance to the quality control test being used for the concrete.

- Allowance for variability and also for difference that are possible between material potential and as built values to allow for construction effects.

Many larger infrastructure projects have defined performance requirements, the achievement of which cannot be assumed, but needs to form part of the quality assurance of the contract.

Understanding the performance of concrete could be improved by agreeing on appropriate methods and developing more local data (see Figure 3). This research would then allow for the following:

- Comparing the performance of alternative binders that potentially could be used in New Zealand in the future.
- Proving equivalence such as in the debate about the inherent durability of precast concrete where no wet curing may be applied after initial accelerated curing in the case where a higher strength grade was used compared with that specified.
- Optimising concrete mixes for sustainability reasons without compromising other properties such as durability.

This article is based on the paper "Moving Towards Model Specification Guidelines for the Supply of Ready Mixed Concrete in New Zealand" by Dr James Mackechnie, presented at the 2015 New Zealand Concrete Conference in Rotorua.

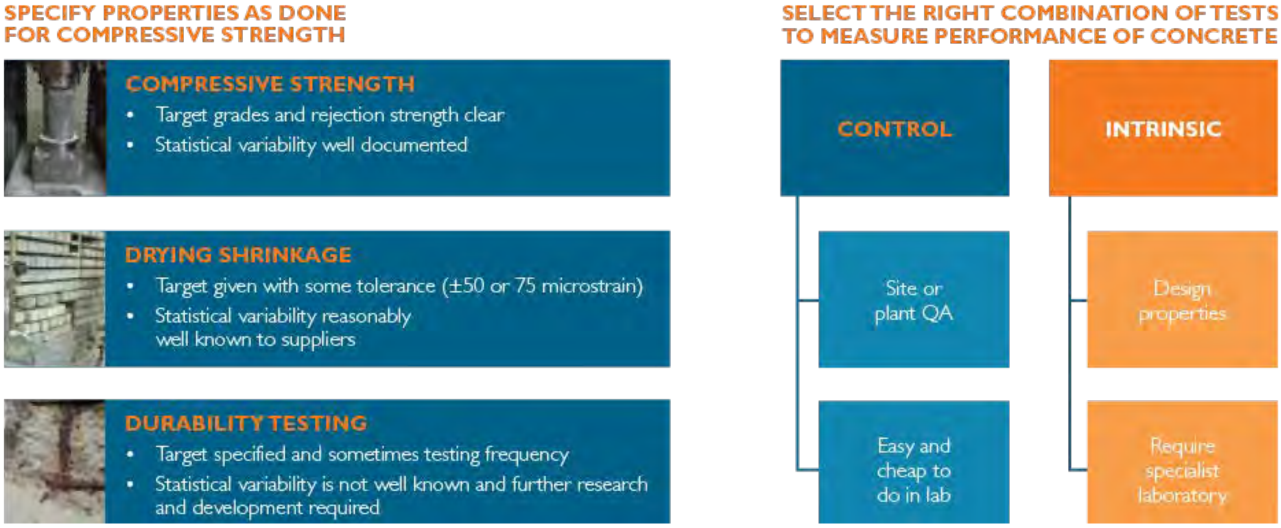

Figure 3: Performance framework for more commonly specified properties

Concrete NZ
PO Box 448
Wellington 6140
Level 4, 70 The Terrace
Wellington 6011
NEW ZEALAND

T: +64 4 499 8820
E: admin@concretenz.org.nz
W: www.concretenz.org.nz