Troubleshooting with Concrete

- a Pre-mix Suppliers Perspective -

By: Joe Pietrosanto

TJM Operations Pty Ltd

Trading as: VIC MIX

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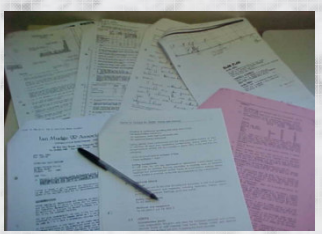
Introduction

Some typical problems faced by Concrete Suppliers:



- While tendering for supply;

- In the batch plant

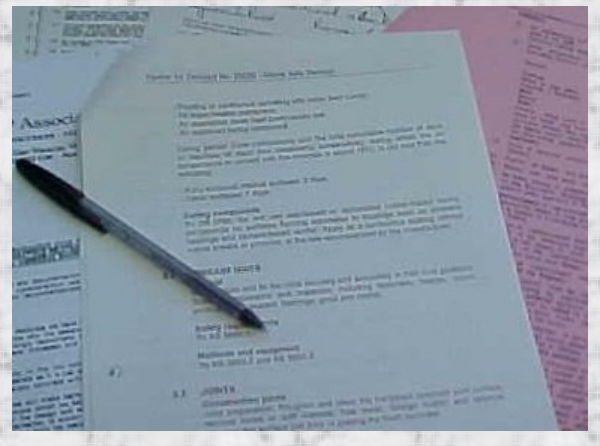
- on the construction site;

and how they are resolved.

Tendering for supply

- Verbal requirements / orders

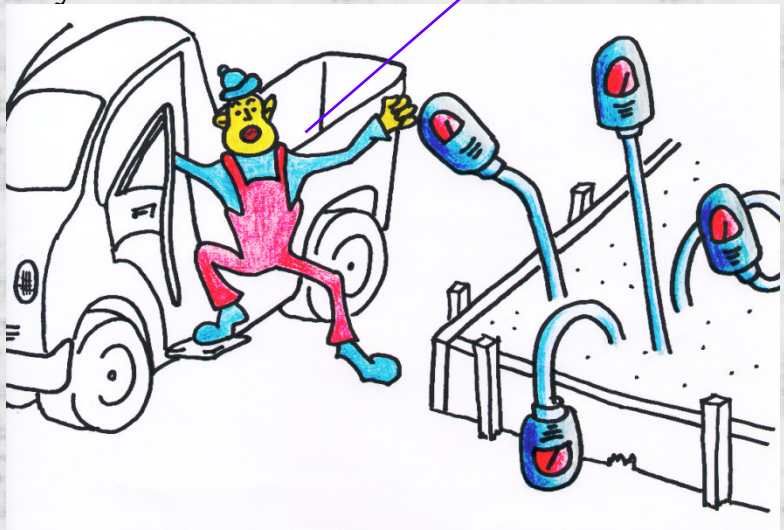
- Written requirements / specifications



Verbal Requirements / Orders

- The majority of price enquiries are received verbally
- Most jobs do not have a written specification.
- Sometimes, the specification is a note on a working drawing
- Often, the tender submission and review will take place in a single conversation which may result in concrete on site within the hour

When I said 4 “Meters”, I meant “Concrete” !!!



The most common problem is:

- Misunderstanding of important project details and requirements

Handling Verbal requirements

- Enquiries are received in a modern Call Centre
- Computer systems control customer and project details
- Customer Service staff are trained to communicate effectively

Typical Central Order Sales Office

Computerised Systems control
Customer details, enquiries and orders

Environment, technology and training work to improve communication

Written Specifications

All major projects have written specifications

The problems faced by Concrete Suppliers are:

- Securing a current and complete copy of the Project Specifications from our potential Customers.
- Interpreting the specification and designing concrete mixes to meet all relevant requirements.
- Completing this entire process in as short a time frame as possible.

The Concrete Industry sells concrete like pizza. Product can be ordered and delivered within the hour.
The ingredients are different for each order and the product must reach the Customer while it is still fresh

Specification Requirements

Specifications often contain prescriptive and performance based requirements which aim to ensure the best possible concrete is supplied.

Problems arise for the Pre-mix Concrete Supplier when

- requirements conflict; or
- requirements are not practical or commonly accepted

The concrete shall not exhibit any shrinkage

No admixtures shall be incorporated

The number and rate of concrete slump tests shall be at the rate of one (1) test per truck.

Aggregates shall be delivered to the Concrete Plant at least 24 hrs before batching

The concrete produced will be allowed the following tolerances as required for workability:

Combined Aggregate Grading	Tolerance for % passing sieve
Aggregate passing 4.75mm sieve or larger	+/- 4
Aggregate passing 2.36mm to 0.6mm sieve	+/- 3
Aggregate passing 0.3mm sieve	+/- 2
Aggregate passing 0.15mm to 0.075mm sieve	+/- 1

Target slump for hand placed concrete shall not exceed 20mm

The use of Fly Ash is strictly prohibited

Aggregates shall at all times be dealt with in such a way that the exact weight of any one size of aggregate may be incorporated in a batch of concrete in accordance with the approved design of a batch to meet the strength and density requirements.

mix design shall match the attached combined particle size distribution

Contract Review

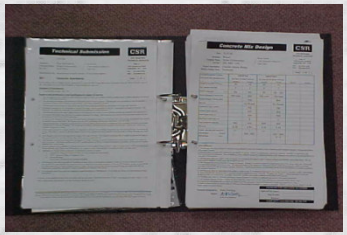
- The customer's pricing inquiry is reviewed to ensure that requirements are understood and to examine our capacity to meet them.
  - This process involves
    - using experience and technology to meet the Customer's needs
    - ensure that pricing is carried out in accordance with Company Policies
    - ensuring we have the resources and capabilities to meet the requirements
    - isolating requirements that cannot be complied with and resolving them prior to acceptance

Address the project requirement

Submission for supply of Concrete

Submit the concrete mix designs

Submit the products and prices



Submit the conditions for supply

Submit features or clarification with the specification

Submit the performance data

Performance Testing

- Pre-mixed Concrete Suppliers are continuously expanding their testing capabilities to meet Customer requirements

Slump Testing

Air & Yield Testing

Compression Testing

Indirect Tensile Testing
(Brazil or Splitting Test)

Core Testing

Shrinkage Testing

AVPV Testing

Flexural Testing
(Modulus of Rupture)

Problems at the Batch Plant

- Materials Contamination

- Batching tolerances

Contamination in Raw Materials

- some objects recovered from concrete over the last couple of years

Wood

4 x 4 x 60 cm long

Probably a broken formwork stake
Source unknown

Cast Iron

1 x 10 x 50 cm long twisted and corroded piece of iron

Source unknown

Aluminium plate

0.5 x 14 x 27 cm
Heavy wear on one end

Source unknown

Clay Lump

Approximately 16 cm diameter

Contamination is most likely from the Sand Quarry Pit

Rock Spall

Approximately 10 cm diameter Hornfels rock

Contamination most likely occurred at the Quarry

Reducing contamination

- Improved Bin Systems fitted with grates to reduce the possibility of contaminants entering the production process

Ground bins allow multiple specialist aggregate products to be stored without contamination.

Concrete Plant Bins

The Grates prevent:
• people falling inside the bin
• as well as exposing and preventing large contaminants from entering the bin

Batching Tolerances

- Meeting batching tolerances are a prime concern for every concrete plant
- AS1379 recognises that tolerance are a practical necessity and has set requirements for all concrete ingredients.
- Errors in batching can alter the concrete's expected properties.

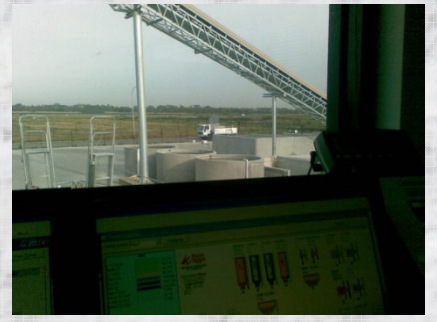
Some examples are:

- Under batched cement may result in strength loss
- Over or under dosed admixture may result in setting time variability
- Over batched coarse aggregate may result in reduced pumpability
- etc.

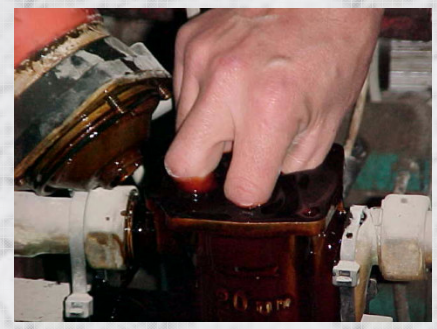
Ensuring tolerances are met

- Computers control batching and ensure tolerances are met
- Regular maintenance and calibration of equipment reduces the number of plant malfunctions

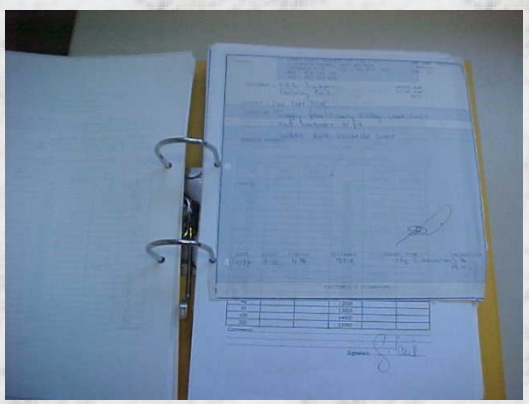
Computer systems



Equipment maintenance



Calibration Records

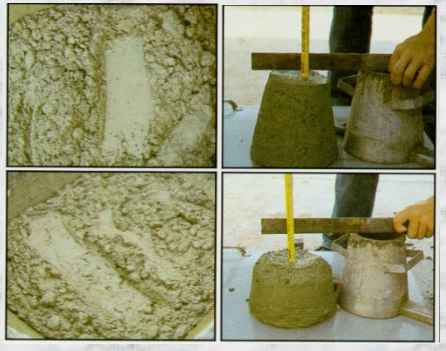


Problems on site

- Placeability and Pumpability
- Concrete Bleeding and setting time
- Concrete Defects

Placeability and Pumpability

- Placability and pumpability is generally dictated by the following:
  - Consistency or slump
  - Volume of fines
  - Size, shape and texture of coarse aggregates
- Placability and pumpability is generally improved by:



Increase in slump/consistency

Increase in paste volume

Increase in roundness
Decrease in size of aggregate

Pumping Lightweight

- Significant cost savings are enabled with the use of lightweight concrete in the construction of highrise buildings.
- However, Lightweight can be difficult to pump and place successfully.
- Two factors are the most challenging when using lightweight in high rise construction
  - The aggregate; and
  - The vertical pumping distance.

Highly vesicular porous rock
Typically 1600 kg/m3

Highrise Construction

Pumping Lightweight

- The key to pumping porous vesicular aggregates is pre-treatment at the Concrete Plant
- Water sprays keep the aggregate saturated

The result is:

lightweight concrete capable of being pumped more than 25 floors in height.

IBM & HWT City Road

222 Russell Street

Concrete Bleeding

- Bleeding is the name given to the action of water rising to the top of concrete shortly after compaction. Factors which affect bleeding are:
  - Rate of evaporation
  - Consistency or slump
  - Volume of fines in the mix



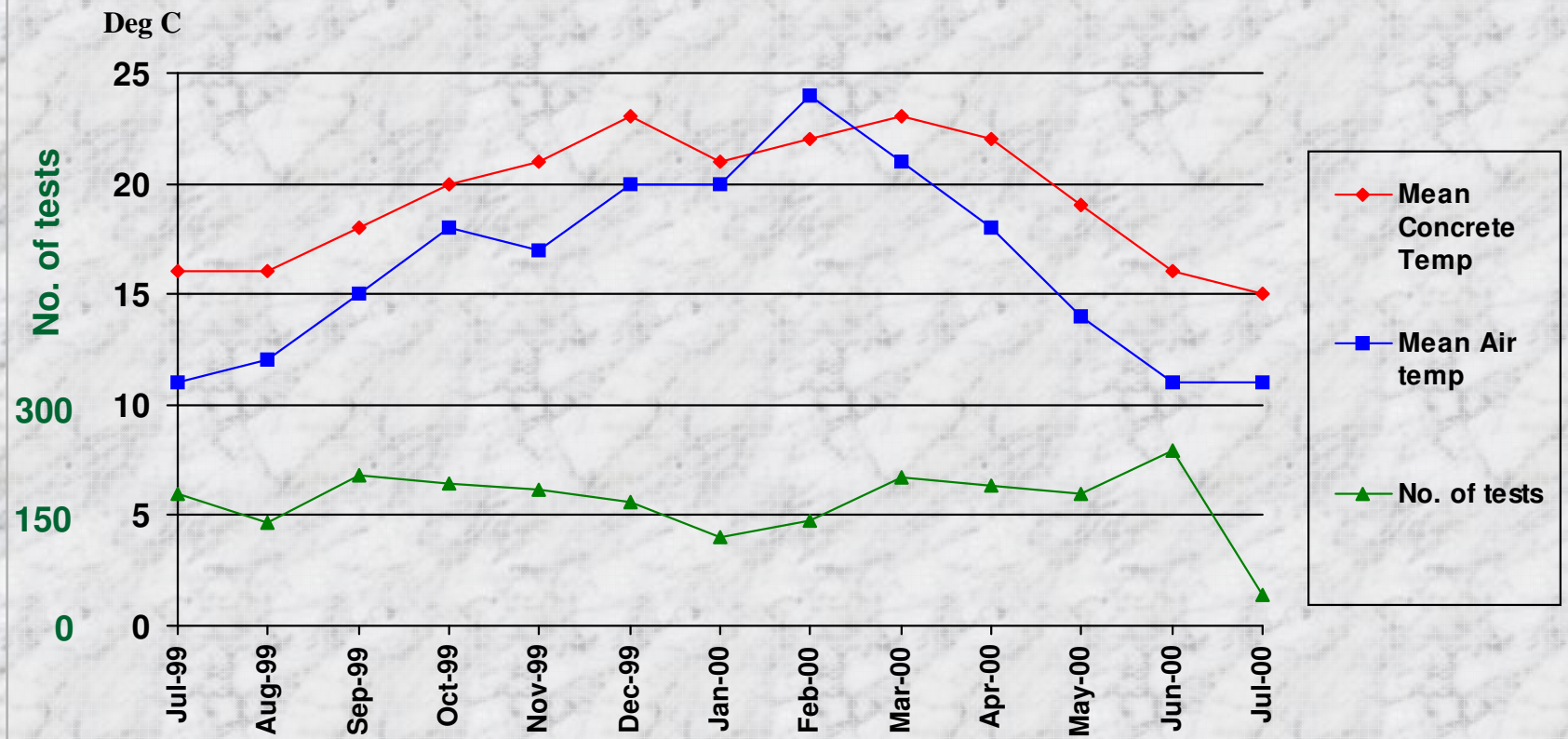
- Bleeding is generally reduced by:
  - An increase in temperature and the evaporation rate (ie summer time)
  - A reduction in the water content of the mix
  - An increase in the ultra fines content of the mix
  - The use of specialist admixtures (ie Air Entrainers, fibres)

Concrete Setting Time

- Setting Time describes the period of time it take for the concrete to stiffen and harden. Factors which affect setting time are:
  - Temperature of concrete

Concrete Setting Time

- Graphed temperature data
  - based on field tests performed on concrete in the field.



Concrete Setting Time

- Setting Time describes the period of time it take for the concrete to stiffen and harden. Factors which affect setting time are:
  - Temperature of concrete
  - Quantity of mixing water
  - Type of cements used in the concrete
  - The presence of admixtures

- Setting time is generally reduced by:
  - An increase in the concrete temperature (ie summer time)
  - A reduction in mix water (ie reduce slump)
  - The use of primary cementitious binders
  - The use of non-chloride set accelerating admixtures

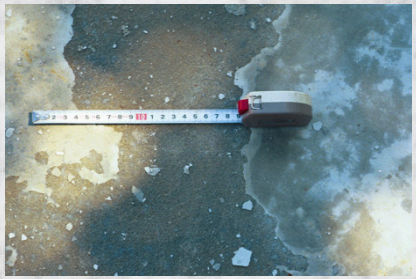
Concrete Defects

- The vast majority of complaints relate to defects in flatwork
  - Scaling
  - Dusting
  - Cracking
- Most of these defects can be reduced or eliminated with the appropriate site practices
- Prevention is always better than a cure

Concrete Scaling

- Scaling, blistering, delamination is when the outer surface of the concrete peals or pops off in a thin layer
  - the depth of the defect is shallow
  - it typically occurs under conditions of high surface evaporation





- Things to watch out for:
  - Don't allow the surface to dry out. This may form a skin under which bleed water and air can become trapped
  - Don't add water to the surface during finishing. This may re-hydrate the past, but leads to separation from the underlying concrete
  - Protect the surface from drying out and apply even continuous curing asap

Concrete Dusting

- Dusting is characterised by the appearance of a fine powder as the surface wears under very light loading conditions
  - the defect is limited to the outer surface of the concrete
  - low cement content mixes are more susceptible



- Things to watch out for:
  - Do not perform any finishing operations while bleed water is on the surface
  - Be wary of additional bleed due to placement over a non-absorptive subgrade
  - Ensure the surface is protected from drying conditions
  - Apply even continuous curing asap

Plastic Cracking

- Cracks which occur in the first few hours after placing as the concrete stiffens
  - often not visible or noticeable until the next day
  - most common in flat work under conditions of high evaporation



- Things to watch out for:
  - Remember to dampen the subgrade and forms during hot weather
  - Erect wind breaks and spray aliphatic alcohol on the surface
  - begin even continuous curing as soon as possible
  - avoid placing concrete on hot, windy days

End of Presentation

- Thankyou for your attention