

Advanced Construction Materials Series

Ready Mix Concrete: PSDAS Technical Visit

Ready-Mixed Concrete Batching Plants

25 June 2011

Hong Kong – China Concrete Co., Ltd.
Tong Yan San Tsuen Batching Plant

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Tong Yan San Tsuen Concrete Batching Plant San Fui Street, Yuen Long



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Sea-front



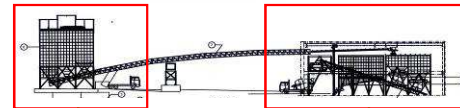
In-land



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Plant Layout



Aggregates Loading and Storage Bins

Cement silos, PFA silo, Silica Fume Silo, Admixture Tanks, Mixers, Weighing bins/hoppers, Unloading points, Slump Stand, Ice machine, Control Room & etc.



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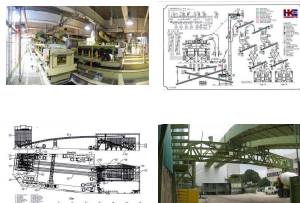
San Fui Street, Tong Yan San Tsuen, Yuen Long

Plant Area : 2,457 m²

Gross Floor Area : 1,446 m²

Built-over Area : 1,176 m²

Building Height : 13.5 m



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Typical Batching Plant



TYST Batching Plant

Restricted Building Height : 13.5 m



Cementitious
Storage



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**Stock capacity of different materials of
Tong Yan San Tsuen batching plant**

Type of material	Capacity (Tonne)
Cement	450
Pulverized Fuel Ash (PFA)	150
Silica Fume	50
Aggregates	1900



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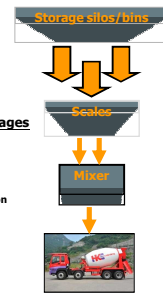
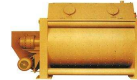
Wet Mixing:

Twin-Shaft Mixer



**Advantages and disadvantages
of wet mixing**

- ✓ High concrete quality
- ✓ Less environmental pollution
- ✗ High maintenance cost
- ✗ Low productivity



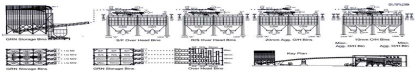
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Commencement of Production :-
March 2005

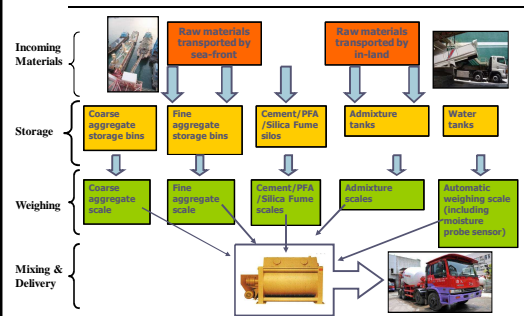
Daily productivity can reach
2,000 cubic meter

(Covering the markets in the western and northern
parts of the new territories)



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Operation Flow



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(I) ISO 9001 – Quality Management Systems

**(II) Quality Scheme For The Production And Supply Of Concrete
(QSPSC)**

- Developed by HKQAA



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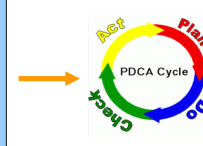
ISO 9001



- ISO 9001 is adopted by Concrete Producers as a basic quality system
- These principles can be used by top management as a framework to guide their organizations towards improved performance
- According to ISO 9001:2008, the basic for the quality management standard is formed by eight quality management principles
- Continual improvement of products

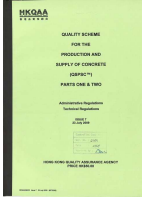
•Eight Principles

- Customer focus
- Leadership
- Involvement of people
- Process approach
- System approach to management
- Continual Improvement
- Factual approach to decision making
- Mutually beneficial supplier relationships



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Quality Scheme For The Production And Supply Of Concrete (QSPSC) – Product Certification



- QSPSC is a tailor-made regulation for the concrete producers in Hong Kong.
- Ensure all concrete provided by Participants meet Purchasers' specified requirements.
- It was published by Hong Kong Quality Assurance Authority (HKQAA) in August 1991.
- The Work Bureau endorsed the requirement specifying that producers supplying concrete to government projects in Hong Kong shall be certified to QSPSC on 8th March, 1994.
- The QSPSC requires concrete producers to operate in accordance with ISO 9001 requirements concurrently

QSPSC Basic Requirements

Example :-

Item	Requirement (i.e.)
Control of purchased materials quality	Regular inspection and testing
Concrete Mix Design	Establish strength to cementitious content or w/c ratio relationship (i.e. Basic Range)
Accuracy of weighting equipments	Cement, PFA, aggregate and water: –within 2% of the weight in the batch Admixtures: –within 5% of the amount added to the batch
Concrete quality	Concrete sampling for compressive strength test at 7 and 28 days
Mixer performance	Compliance of AS1379 standard

Management concept of QSPSC can be basically divided into:

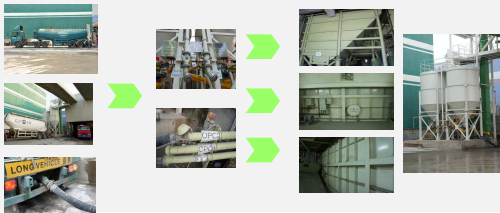
1. Incoming Raw Materials Control
2. Design Control
3. Production Control
4. Quality Control
5. Equipment Calibration and Maintenance Control



(1) Incoming Raw Materials Control

(1) Incoming raw materials control :- Cementitious materials

- Separated weatherproof storage silos/bins with efficient dust control and discharge systems
- Different load connectors are equipped for different materials' silos/bins
- The inlet of each silo/bin is clearly marked to indicate the type of its content



(1) Incoming raw materials control :- Cementitious materials

Sampling of Cementitious Material randomly from tanker on delivery



Carry out testings on cementitious materials

(1) Incoming raw materials control :- Aggregate



- Storage bins are provided for each nominal size and type of aggregates
- Avoid contamination and to prevent intermingling with adjacent material
- Storage bins for each type of aggregates are clearly labeled and identified

(1) Incoming raw materials control :- Aggregate



Aggregates are visually inspected and verified on delivery



Aggregates shall be sampled and tested

(1) Incoming raw materials control :- Aggregate

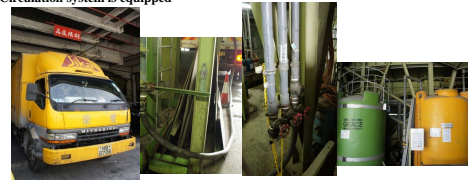
Field Settling Test (Silt content by volume)

- Volumetric method test is carried out at plant at once a day
- Check the silt, clay & dust content of crushed stone fines



(1) Incoming raw materials control :- Admixture

- Tanks or drums containing admixtures are clearly labeled and avoid contamination
- The inlet of each admixture tank is clearly identified
- Circulation system is equipped



(1) Incoming raw materials control :- Admixture

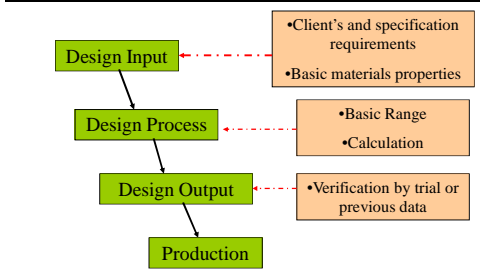
- Sample the admixture on deliver
- The colour of admixture sample is visually verified
- Specific gravity checking
- Carry out testing on admixture in laboratory



(2) Design Control

(2) Design control :-

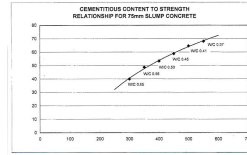
Procedure flow



(2) Design control :-

Basic range

•Typical Basic Range



•Typical Design Form

A detailed design form for concrete, including sections for General Information, Design Data, and Design Results. It contains various fields for project details, material properties, and design calculations.

(2) Design control :-

Strength requirement of design mixes

Target mean strength = Specified strength + (Designed S.D.) * (K factor)

>Designed S.D.: ≥ 3.5 MPa

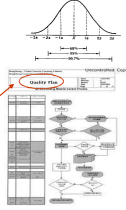
>K factor: 2 or such greater required by specified rules

The design S.D. shall be 6 MPa when

- >A new batching plant comes into operation
- >An existing plant reopens following closure
- >Unpredictable materials changes

For high strength concrete (Grade 60 or above)

"Quality Plan" is required



(2) Design control :-

Actual design margin

Strength compliance requirements for designed mixes (General Specification)

Specified grade	Compliance requirement	Average of any 4 consecutive test results shall exceed the specified grade strength by		Any individual test result shall not be less than the specified grade strength by more than	
		100mm Cube	150mm Cube	100mm Cube	150mm Cube
20D and above	C1	7 MPa	5 MPa	2 MPa	3 MPa
	C2	5 MPa	3 MPa	2 MPa	3 MPa
Below 20D	C1 or C2	3 MPa	2 MPa	2 MPa	2 MPa

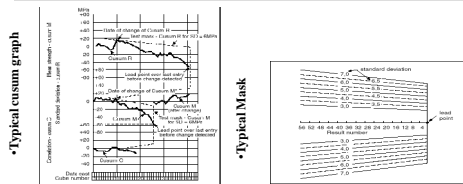
In General, as to cope with the general specifications' strength compliance requirements, the actual design margin will be greater than QSPSC's requirement

(2) Design control :-

Cusum

•Cusum is plotted graphically against the sequence of results, a visual presentation of the trend relative to the target level is produced.

•The cusum system is used for monitoring trends in mean strength, standard deviation and the relationship between early-age and 28-day strengths.



(3) Production Control

(3) Production control :- Batching System



PLC (Programming Logical Control) system oriented



(3) Production control :- Batching System

Automatic system :-

CCTVs and monitoring panels are equipped to supervise the whole production process

•Raw materials weighing and fresh concrete mixing are conducted by computerized automation system

•All the batching data and records are noted for tractability



(3) Production control :- Devices



- Slump indicator
- Workability control
- Double-value
- Admixture control
- Moisture Probe
- Moisture adjustment
- Alarming measures
- Batching error
- and etc.

(3) Production control :- Mixing



Materials to be batched within the tolerances as the following table:

Type of Materials	Accuracy
Cement, GGBS, PFA, Aggregate and Water	within $\pm 2\%$ of the weight in the batch
Silica Fume	0% to $\pm 5\%$ of the weight in the batch
Admixture	within $\pm 2\%$ of the amount in the batch

(3) Production control :- Visual inspection & checking

- Each load of mixed concrete shall be inspected by a competent person before despatch
- Measure and record the concrete temperature (if temperature controlled concrete is produced)
- Concrete mixes shall be randomly sampled and tested for workability
- Perform workability test if the production is less than $3m^3$
- Confirmation in the delivery note when the inspection process completed



(3) Production control :- Control measures by truck-mixer driver

- Wash-out in drum shall be discharged before loading
- Computerized scanning system is equipped for verifying delivery note and location of site
- When arrival on site, truck-mixer driver confirms the delivery note with site people before discharging
- Rain-cap is covered on mixer-truck's hopper to prevent contamination during rainy day



(4) Quality Control

(4) Quality control :- Raw Material and Concrete Testing

Material and Concrete Testing Schedule - According to QSPSC and General Specifications

Cement		RVA		Aggregate	
Tests	Frequency	Tests	Frequency	Tests	Frequency
Chemical	once per five months	Chemical	once per five months	Grading	daily
Physical	once per month	Physical	once per five months	Sh Content	daily
Blank Range	once per six months	Plasticity	weekly	Sulphate Content	once per two months
		Moisture Content	weekly	Shrinkage Value	monthly
				Water Absorption	monthly
Silica Fume		Water			
Tests	Frequency	Tests	Frequency		
Physical & Chemical	once per six months	Chemical	once per five months	Relative Density & Water Absorption	once per four months
				Shrinkage Content	once per four months
				Shrinkage	once per five months
				Shrinkage	once per five months
Admixtures		Concrete			
Tests	Frequency	Tests	Frequency		
Chemical	monthly	Shrinkage	monthly	Impact Value	once per five years
		Compressive Strength Test	daily	Los Angeles Value	once per five months
		(7 days & 28 days)		Magnesium Sulphate Soundness	once per five months
				Slower Bar Test	once per four months
				Aggregate Potential Reactivity	When new source of aggregate used

(4) Quality control :- Raw Material and Concrete Testing

Additional In-House Tests

Aggregate		Concrete	
Tests	Frequency	Tests	Frequency
Methylene Blue Test	daily	Compressive Strength Test	daily
Field Setting Test for Fines	daily	(3 days & 56 days)	
		Lab. Trial of Control Mix	daily
		(24 hrs accelerated at 55°C)	



(4) Quality control :- Laboratory

Carry out laboratory testings to assure all raw materials and products are in compliance with standards and all of our clients' requirements



(4) Quality control :- Site

Carry out field testings to assure all products are in compliance with clients' requirements



(5) Equipment Calibration and Maintenance Control

(5) Equipment Calibration and Maintenance Control :-
Calibration Frequency - Laboratory

[illegible]

(5) Equipment Calibration and Maintenance Control :-
Calibration Frequency - Plant

Item	Calibration Frequency
Standard Weight	once per year
Measuring Thermometer	once per year
Speedy Moisture Tester	once per year
Moisture Probe	once per year
Plant UPS Functional Test	monthly
Scale Calibration (Internal)	monthly
Scale Calibration (External)	once per three months

(5) Equipment Calibration and Maintenance Control :-

Project Portfolio

