

# Excelicrete Overview

**PJA Holdings, LLC**

# Presentation Overview

- Intelligent Concrete Overview
  - Mix Design Technology
  - Intelligent Concrete System and Quality Control & Assurance
- Intelligent Concrete Test Performance
  - Intelligent Concrete Historical Reference
  - Intelligent Concrete Current Projects

# Mix Design Technology

## ■ CONVENTIONAL APPROACH

- Design for strength and slump by standard Tables
- Requires excessive trial and error and 28D
- Approximation of strength and workability at best
- No way to know if mix is optimized
- Poor water control
- Large standard deviation on slump and strength
- Large over-design required to reduce risk of failure
- Segregation and bleeding problems at slumps >150 mm

# Mix Design Technology

## ■ Intelligent Concrete Approach

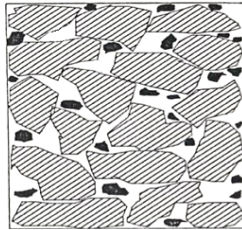
- Optimize aggregates ratio through particle packing
- Reduces water demand
- Reduces Bingham viscosity through optimization of sand to rock ratio
- Increases cohesion and reduce segregation and bleeding
- Determines unique fingerprint for materials used (in 7D)
- Determines true strength potential of all cementitious materials
- Allows for easy design of all strengths (3, 7 and 28D), and slumps without trial and error. All designs will hit required strength plus desired over-design
- All designs can be used for Self Compacting Concrete (even as low as 20 MPa)
- Improved finishability
- Applies Real-Time Quality Management System to keep precise water and materials balance



# Intelligent Concrete Overview

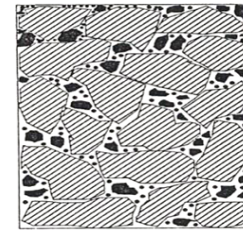
## Mix Design Technology: Intelligent Concrete versus Conventional

### Standard Mix Designs



- Larger void spaces require more water and cement
- Cement paste is the most expensive material in concrete
- Excess cement generates excess heat of hydration
- Excessive trial and error
- No way to predict properties

### Intelligent Concrete Mix Designs



- Void spaces are reduced by **optimized packing** of aggregates
- Sand to aggregate ratio is optimized for reduced viscosity and increased cohesion to give **improved flow and stability**
- Aggregates replace excess cement paste to give **less shrinkage** and **lower cost**
- Lower hydration temperatures
- Easier handling, better flow and easier finishing

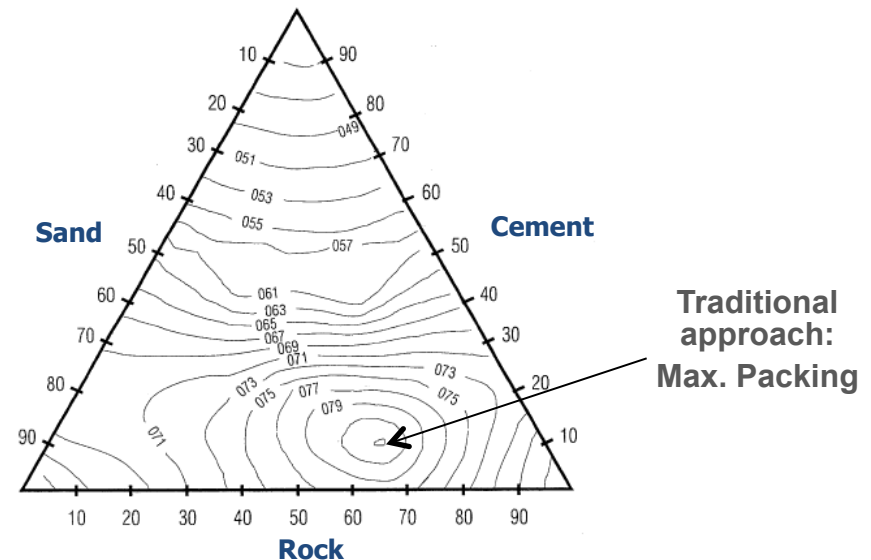
# Mix Design Overview

## Mix Design Technology: Unique and Novel Approach

– Intelligent Concrete designs for optimal:

- Workability
- Strength
- Cost
- Any performance specification

**Ternary Packing Diagram:**

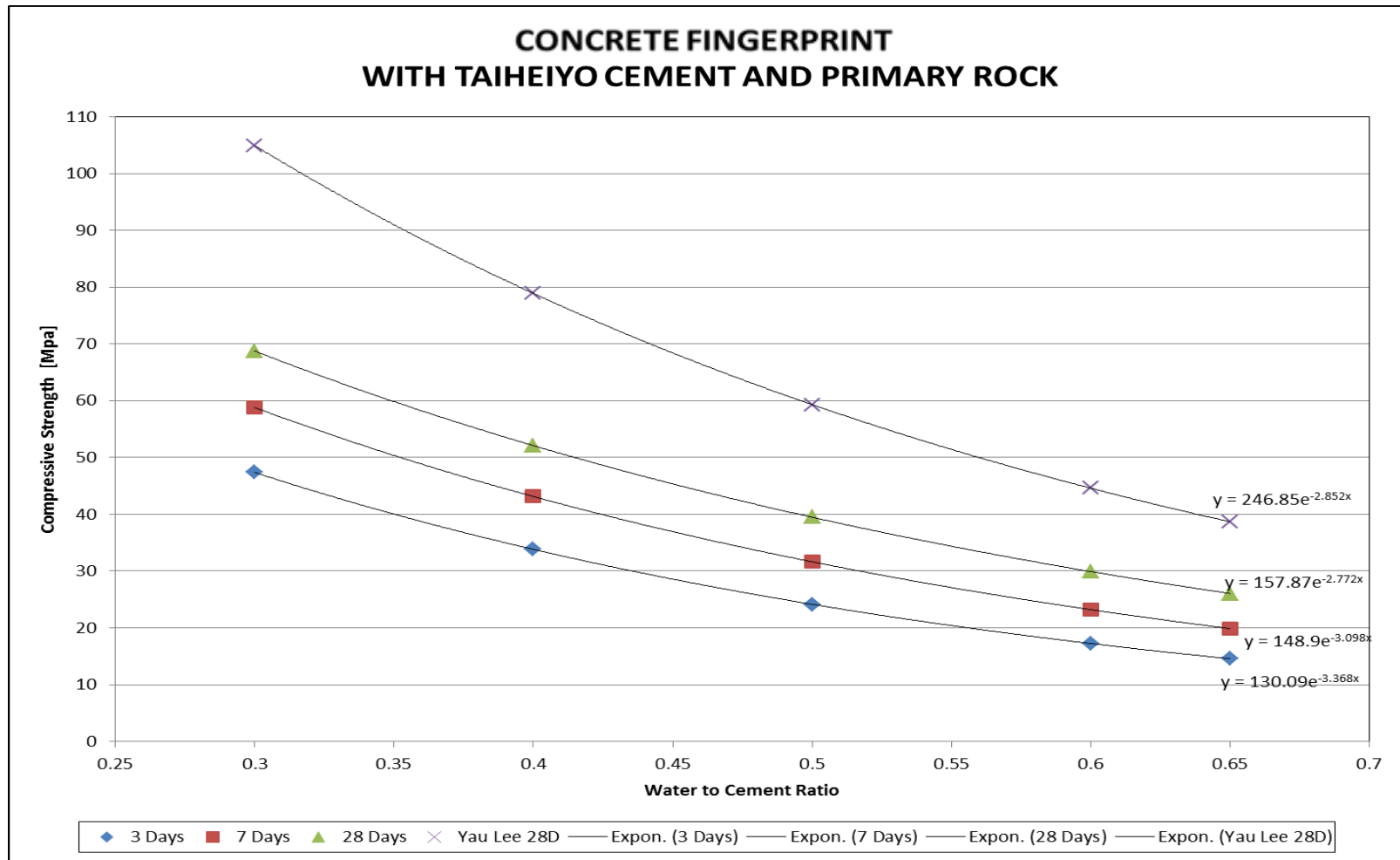


**Intelligent Concrete identifies the optimum particle packing (not the maximum) through the application of its proprietary materials testing methods and computer algorithms**

# Unique Mix Design Qualifiers

- 1. Reactivity of cementitious components**
- 2. Quantified water demand of materials**
- 3. 3, 7 and 28 days fingerprint performance**

# Concrete Fingerprint



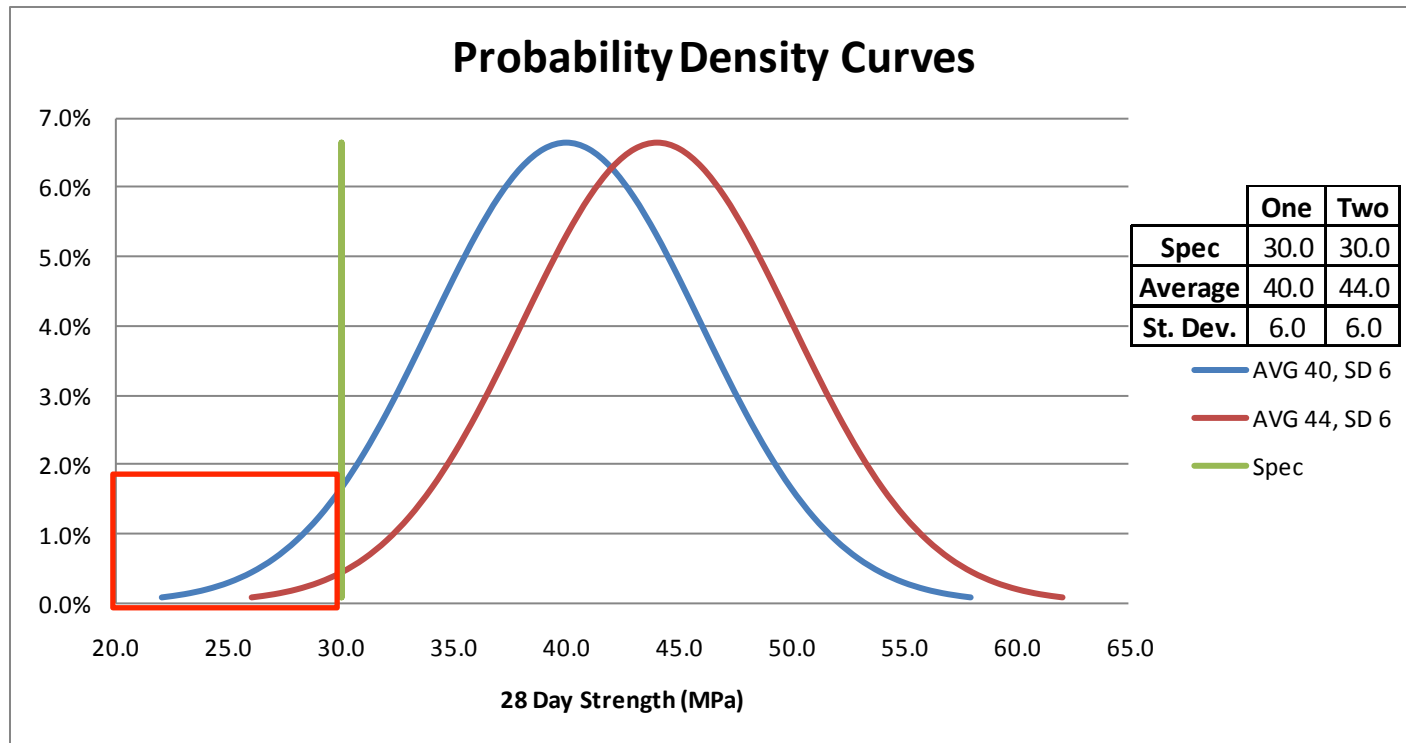
# Traditional QC

- Incoming Materials Control
- Manual Moisture Tests and Inputs
- Batch Ticket:

CLIENTE	PCM CONCRETO SA DE CV		ID DE REMISION	ID DE CARGA	NOMBRE DE PLANTA		
CAMION	USUARIO	CONDUCTOR	NUM DE REM	ID DE REM	HORA	FECHA	
JR-117	USER	J. REYES	8439	6095	18:57	06/09/2007	
TAMANO	MEZCLA				SEC	CARGA ID	
4.00 m3	ICI				D	6619	
MATERIAL	CTD DISEÑO	EXIGIDO	CARGADO	VAR	% VAR	%HUMEDAD	AGUA REAL
SCA2	894 kg	3688 kg	3660	-28	-.76%	3.146% A	111.62 L
AR1	1017 kg	4281 kg	4270	-11	-.26%	5.242% A	212.69 L
CP030R	192 kg	768 kg	766	-2	-.26%		
AGUA	166.0 L	338.3 L	339.0	0.7	0.21%		339.00 L
NON-ESTIMADO		NUMERO DE BACHADAS: 1		MANUAL 18:57:34			
54.0 L		DISEÑO A/C: 0.865		AGUA/CEMENTO: 0.867T AGUA EN MEZCLA: 6			
AGUA REAL: 663.3 L		AGADIR: 0.7 L					
ASENT.:100 mm		AGUA EN CAMION: 0.0 L		AJUSTE AGUA: . 0.0 L /carga GRAD AGU			
A: 0.0 L /m3							
CARGA COMPLETA		TIEMPO DE CARGA:06:44 ----TARAS-----					
AGG SCALE T: 1 CR: 20		TR: 30 kg		CEM SCALE T: 1 CR: 4		TR: -36- kg	

- Unit Weight and Slump
- 1, 3, 7, and 28 Days Strength

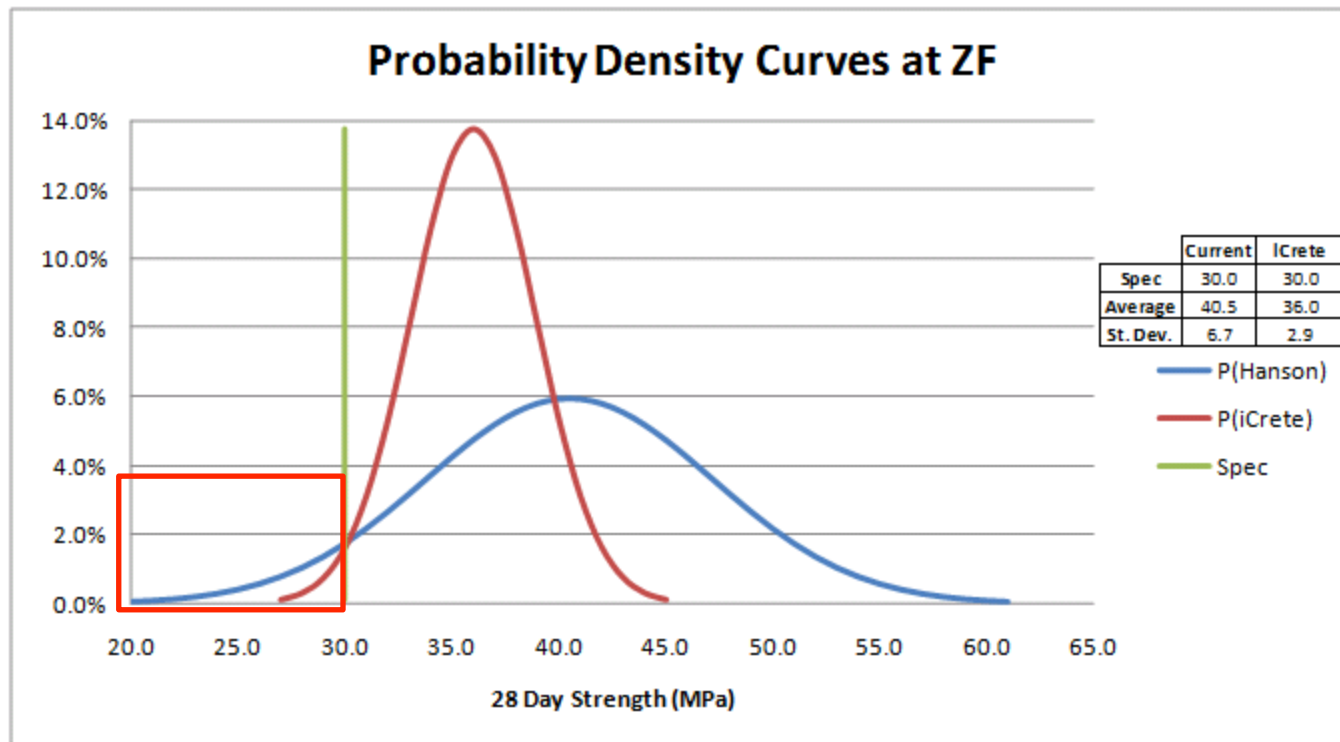
# Over-Design and Failure Risk



**Failure Rate is the area under the curve to the left of the specification line. More over-design equals lower failure rate.**

# Example from Plant ZF.

## Lower Over-Design is Possible Through QC Control

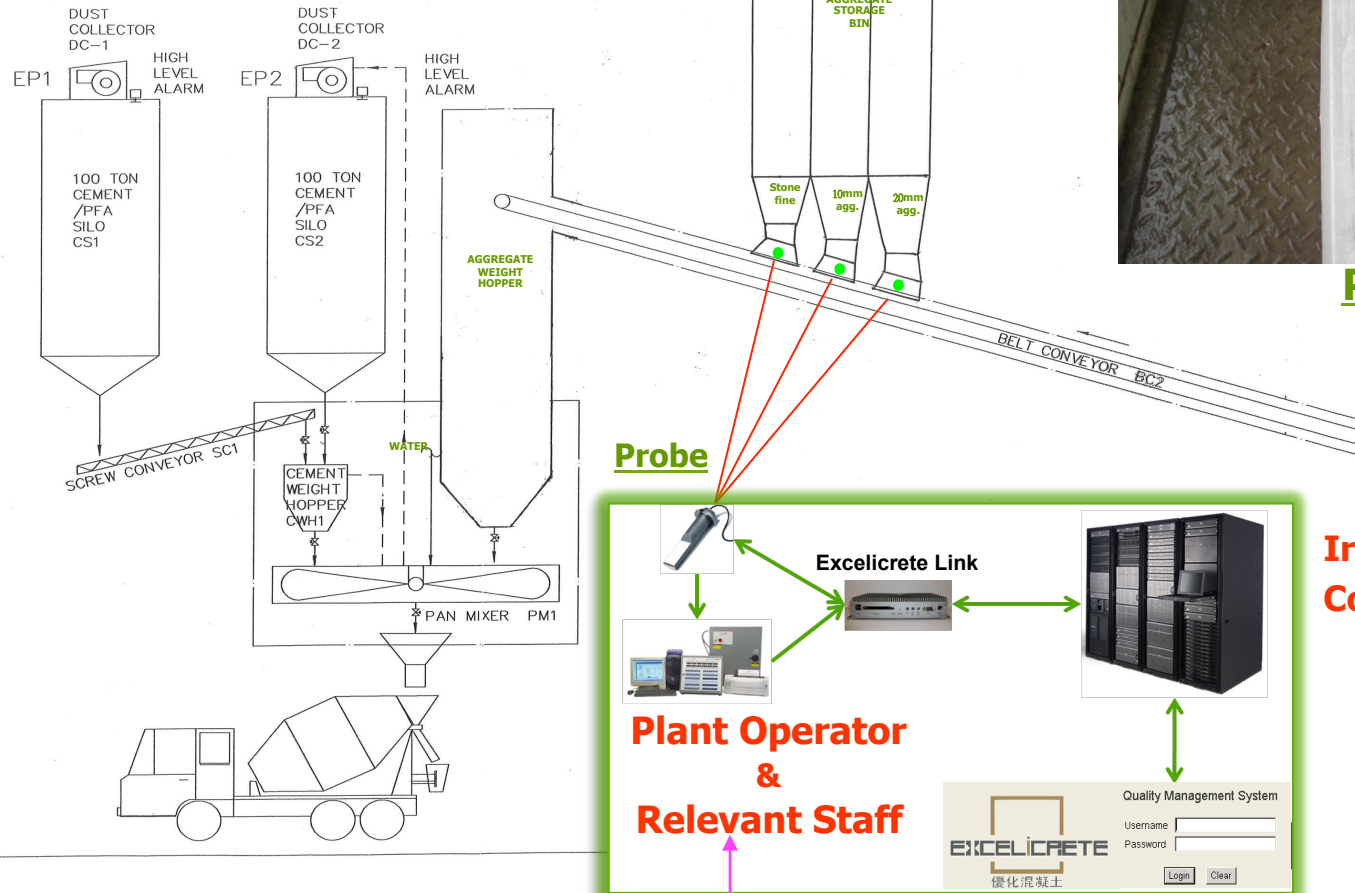


	Failure Rate
Hanson	4.9%
iCrete	1.2%
Savings	€ 3.05

# Intelligent Concrete Overview

## System Structure

The Intelligent Concrete System's Core is the Intelligent Concrete Link and Moisture Probes



Probe

**Irregularities in Concrete Production**

**Alarm Alert**

**By SMS/E-mail**



# Quality Management System

- Welcome Page - Dashboard

The screenshot shows the 'Intelligent Concrete Quality Management System' dashboard. At the top, there's a blue header bar with the system name and window controls. Below this, the main content area has a light beige background. On the left, there's a sidebar with a logo and the text 'EXCELICRETE Quality Management System' and '優化混凝土'. The main area displays a summary of the last batch (4842) and its status (Fail). It also shows a 'Dashboard for Operator' section with details for the last batch (44245) and a table of batching details. At the bottom, there's a 'Material Batching Details' table showing the percentage variance for various materials.

**Intelligent Concrete Quality Management System**

Hide Menu Change Password Logout

Welcome, vhsupport!  
Current Plant: **KT1B\_1**

Last Batch: 4842 Date and Time: 2012-01-11 16:58:25 Design Mix Name: D35/20 D217 Y3235D011 Status: **Fail**

**Dashboard**

- Operator Dashboard

**Dashboard for Operator**

Last Batch: 44245 Date and Time : 2011-01-04 15:34:42  
Design Mix ID : 2344 Design Mix Name : D45/40  
Truck No : DG4223 Status : **Fail**  
Sales Volume 5.6

**Batching Details**

Batch No	Time	Volume	Status	
4	2011-01-04 15:34:42	1.4	Fail	<input type="button" value="Dispose"/> <input type="button" value="Accept"/>
3	2011-01-04 15:33:22	1.4	Okay	
2	2011-01-04 15:31:10	1.4	Okay	
1	2011-01-04 15:30:00	1.4	Okay	

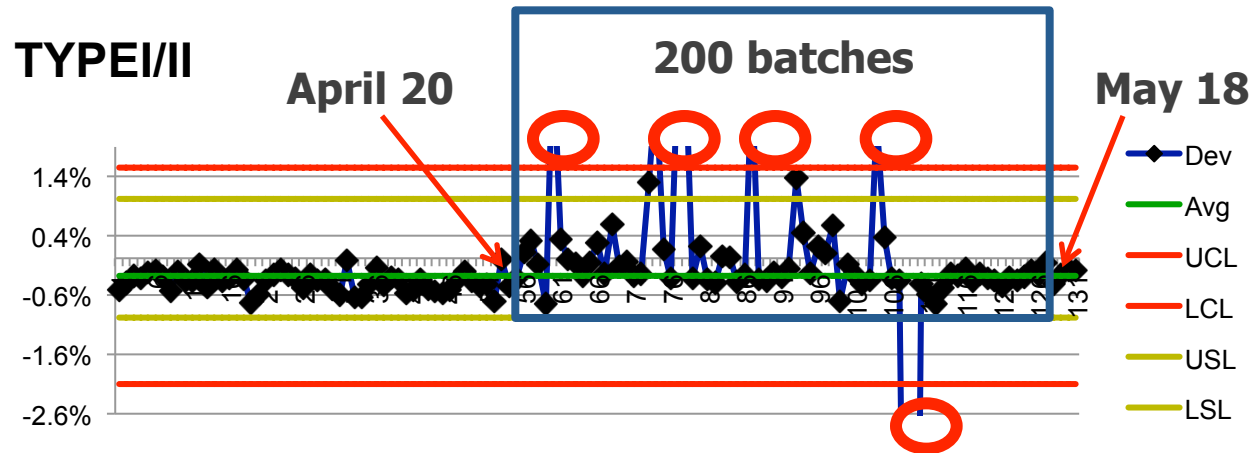
**Material Batching Details**

Material Name	% Variance	Status
10MM	1.34%	Okay
20MM	0.23%	Okay
S/F	1.01%	Okay
Cement	1.25%	Okay
D-17D	4.34%	Okay
Water	2.34%	Fail

# Quality Management System

1. **Generates real-time monitoring of all weights, slump, unit weight, yield, water to cement ratio and strength results**
2. **Use x-charts, Cpk charts and CUSUM charts to evaluate production process**
3. **Identifies batching errors and determines cost of errors**
4. **Provides automated alarms to personnel**
5. **Provides standardized QC and management reports**

# QMS X Charts



- Material is being under weighed
- Errors of batching too much
- Workability issues
- Process limits outside of spec limits
- $C_{pk} = 0.39$

Material Name	TYPE/II
Total Batches	655
Actual Material Used	3,599,930
Target Material Used	3,617,539
Batching Error	-17,609
Total Batching Errors	49
Over Tolerance	29
Under Tolerance	20
Average Batching Error	-0.3%
Standard Deviation	1.0%
Max Batching Error	18.9%
Min Batching Error	-69.4%
Cost of Batching Error	-\$882.67

# Definition of Cpk

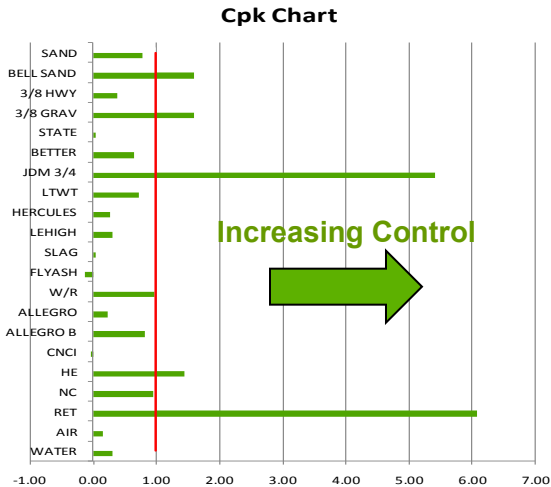
- **Is a measure of process capability**
- **Measures how close a process is running to its specification limits**

$$\text{Cpk} = \text{Min}(\text{Cpl}, \text{Cpu})$$

$$\text{Cpl} = (\text{mean} - \text{Lower spec. limit}) / (3 \times \text{st.dev})$$

$$\text{Cpu} = (\text{Upper spec. limit} - \text{mean}) / (3 \times \text{st.dev})$$

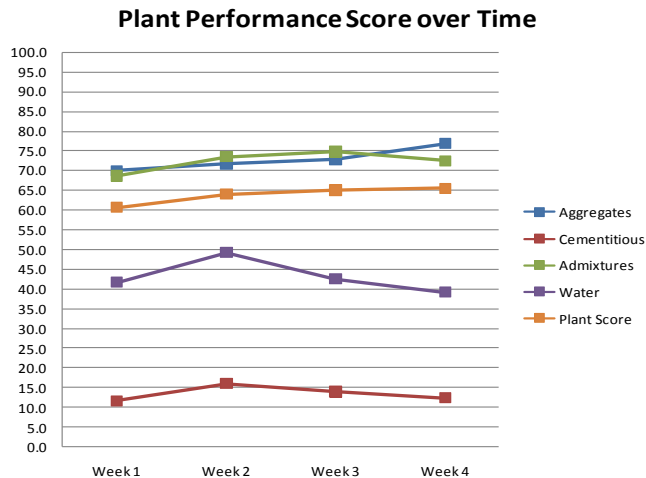
# Cpk Charts



$$\text{Cpk Score} = 100 \times (\text{Parameter Cpk} / 2)$$

Name	Week 1	Week 2	Week 3	Week 4	Month
SAND	52.5	62.5	71.8	95.6	70.6
BELL SAND	80.0	100.0	100.0	100.0	95.0
3/8 HWY	40.0	54.8	62.5	50.6	52.0
3/8 GRAV	80.0	91.2	100.0	100.0	92.8
STATE	2.0	2.1	2.5	2.6	2.3
BETTER	50.5	63.6	60.4	54.4	57.2
JDM3/4	100.0	100.0	100.0	100.0	100.0
LTWT	28.5	38.8	33.2	42.3	35.7
LEHIGH	23.0	26.5	27.0	31.3	26.9
SLAG	0.0	0.0	0.0	0.0	0.0
FLYASH	0.0	0.0	0.0	0.0	0.0
W/R	100.0	100.0	100.0	100.0	100.0
ALLEGRO B	34.5	40.4	48.4	65.4	47.2
ALLEGRO B	31.5	32.1	39.2	32.9	33.9
HE	100.0	100.0	100.0	100.0	100.0
NC	43.0	55.0	45.7	53.9	49.4
RET	100.0	100.0	100.0	100.0	100.0
AIR	11.5	9.7	8.5	11.2	10.2
WATER	27.5	27.8	24.7	27.2	26.8
Yield	55.0	76.5	65.7	67.1	66.1
Unit Weight	100.0	100.0	88.0	83.6	92.9
W/C	22.5	27.5	24.7	33.8	27.1
Plant Score	49.2	54.9	54.7	56.9	53.9

C <sub>pk</sub>	Sigma
1.00	3
1.33	4
1.66	5
2.00	6

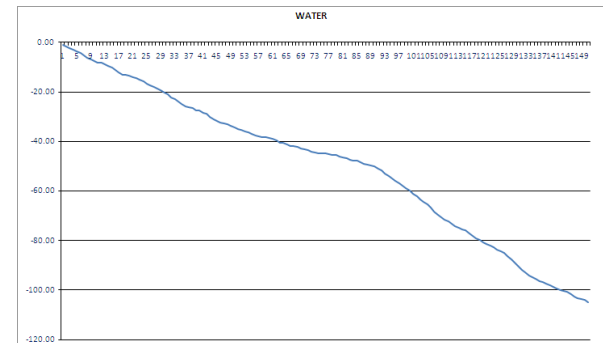
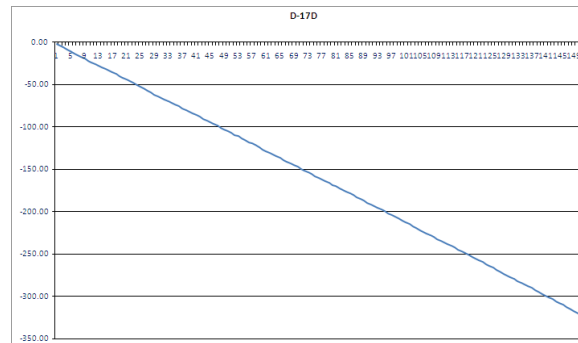
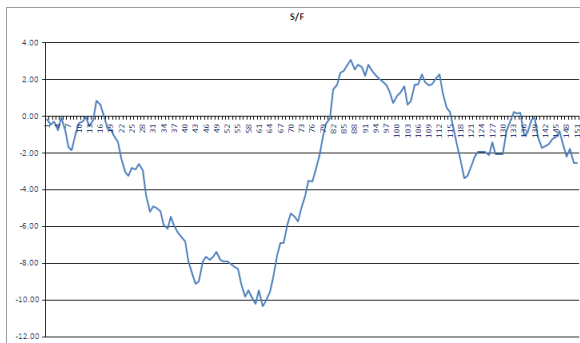
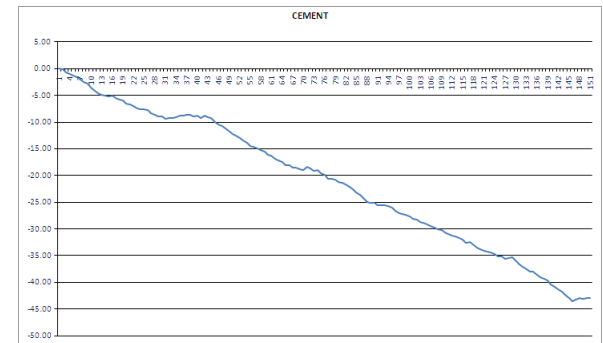
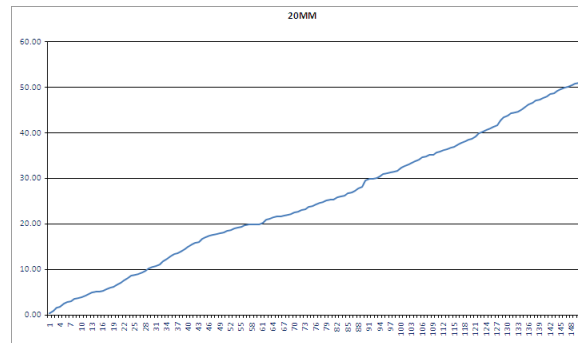
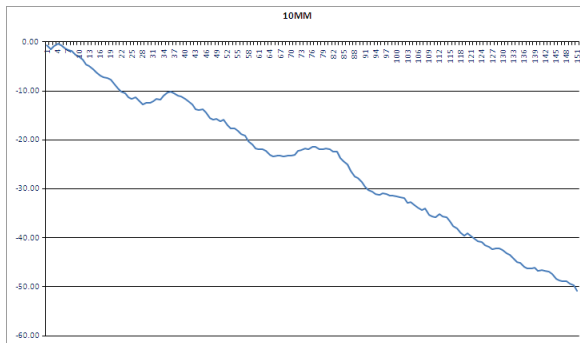


\*Plant Score is the weighted average of all materials and calculations based on the number of times a parameter is used during the time period

# Cusum Charts

- **Cusum Report**

- Cusum Report will be generated for all parameters (including single material and overall parameter).
- Accumulated value of “% variance” for all data points  
(Each Data Point Value = Average of 5 “% Variance” from 5 Consecutive Batches)



# Intelligent Concrete Test Performance

## Test Results of Trial Mixes on April, 2010 at Ma On Shan Site Batching Plant

Cube Strength [MPa]	Concrete grade	D45/20	Intelligent Concrete 45		D35/20	Intelligent Concrete 35		D60/10	Intelligent Concrete 60	
	Concrete Cube Test Result Average (1 day)	21.14	16.79		N/A	14.04		23.36	20.18	
	Concrete Cube Test Result Average (3 days)	44.72	37.82		35.55	N/A		50.31	42.73	
	Concrete Cube Test Result Average (7 days)	55.61	44.6		44.20	40.91		62.86	57.98	
	Concrete Cube Test Result Average (28 days)	65.25	56.15		57.63	52.56		84.28	74.77	
Cement content (Kg/M <sup>3</sup> ):		520	372	Saved 148kg	420	327	Saved 93kg	405	335	Saved 70kg
% of Cement Saving		Less 28% Cement			Less 22% Cement			135 (PFA)	111 (PFA)	24kg (PFA)
								Less 17% Cement		

**Savings on D45 Grade Concrete : HK\$48.26 (US\$6.19) /m<sup>3</sup>**

# Intelligent Concrete Overview Summary

## Intelligent Concrete Design Means:

- More Rock, More Sand
- Less Cement Paste
- Better Workability without More Water
- Lower Porosity / Higher Durability
- Less Shrinkage, Less Creep
- Lower Standard Deviation

## Intelligent Concrete QMS Means :

- Better Control of Raw Materials
- Guaranteed Water : Cement Ratio
- Every Batch Recorded with All Information
- Instant Notice of Potential Problems
- Trends Identified to Prevent Failure

**HIGHER QUALITY, BETTER ENVIRONMENTAL FOOTPRINT, LOWER COSTS**

**KT1B Savings on D45 Grade Concrete : HK\$48 (SGD\$8.0)/m<sup>3</sup>**



# Moisture Probe Requirement

# Moisture Probe Usage

1. Capture Moisture Data by Probe at half batch

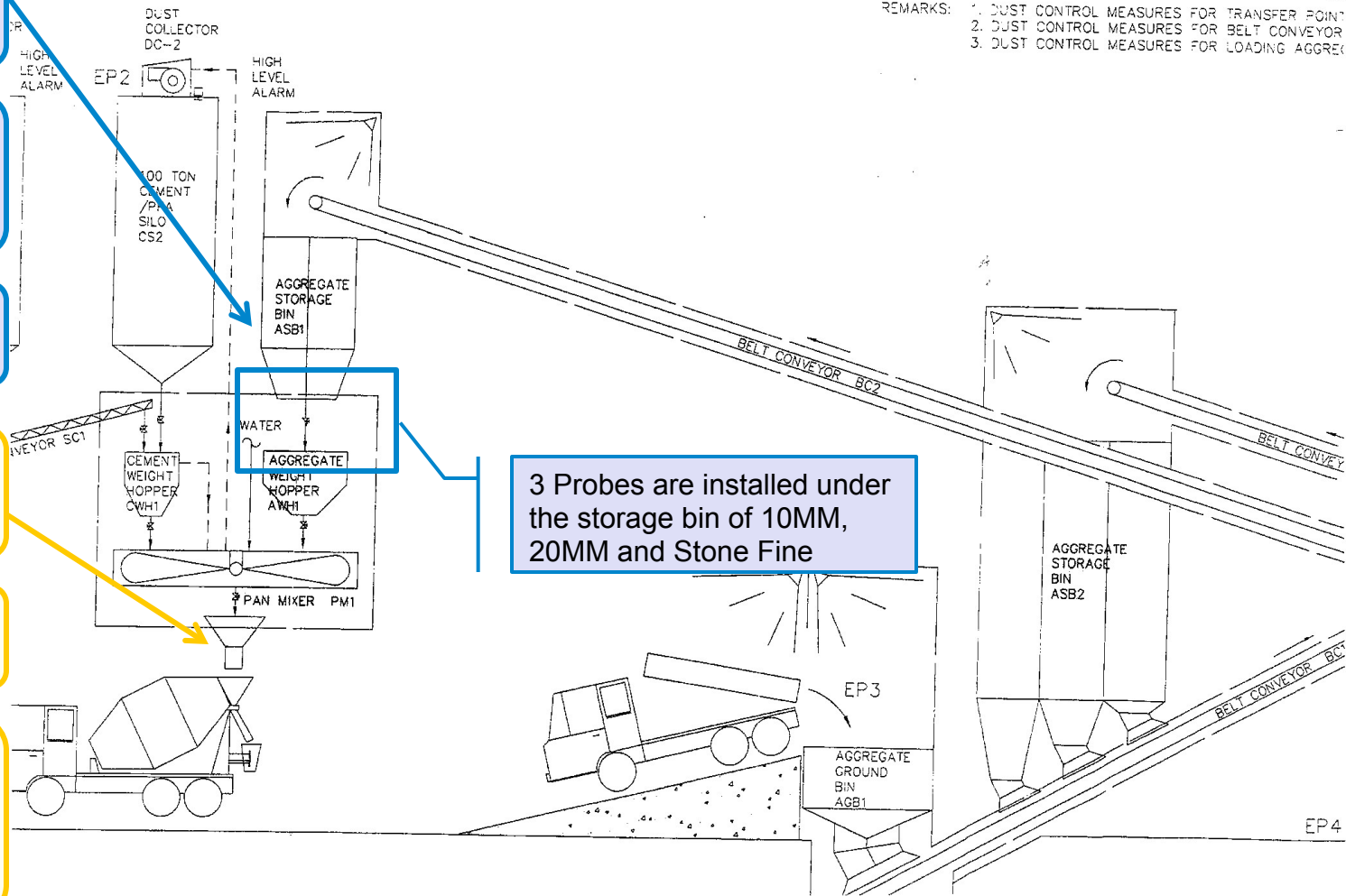
2. Adjust target weight of aggregate and water

3. Capture actual weight of usage

4. Data captured by QMS and performing consolidation

5. Showing alert if exceeding tolerance

6. Generate Report:  
-Performance Report  
-CPK Chart  
-Monthly Summary  
-Cusum Chart



# Probe Installation

- 25 Readings per second will be taken by the probe and response the average value to the batching system.



Probe Installation for 10MM / 20MM

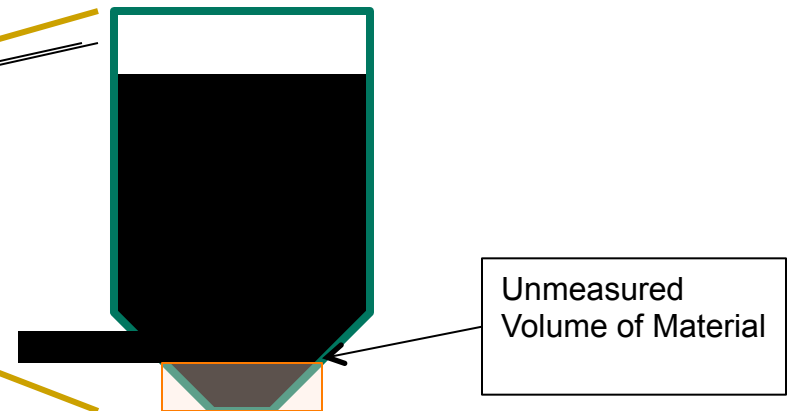


Probe Installation for Stone Fines

# Probe Installation



- Since the probe is installed horizontally at the bottom of storage bin
- Around 30-50kg of material would not be measured in the first batch and return to the storage bin.



# **Experience Sharing of Excelicrete Usage World-wide**



# Intelligent Concrete Performance

- **United States Federal Highway Administration**
- **Strategic Highway Research Program (1988-91)**
- **Great Belt Link Connection Denmark (1988-92)**

- 100 years durable concrete
- $\pm 1\%$  Materials Uniformity

- **Prince Edward Island Bridge, (1994)**
- **Freedom Tower New York City (2008)**
  - Highest Strength Concrete Placed in High Rise Structure in NY
  - Standard Deviation 3MPa
  - $>100$  MPa Compressive Strength



# **Technical Review of Self-Compacting Concrete (SCC)**

# Self Compacting Concrete

## Advantages:

- Can be placed at a faster rate with no mechanical vibration and less screeding, resulting in savings in placement costs.
- Improved and more uniform architectural surface finish with little to no remedial surface work.
- Ease of filling restricted sections and hard-to-reach areas. Opportunities to create structural and architectural shapes and surface finishes not achievable with conventional concrete.
- Improved consolidation around reinforcement and bond with reinforcement. Improved pumpability.
- Improved uniformity of in-place concrete by eliminating variable operator-related effort of consolidation.
- Labor savings.
- Shorter construction periods and resulting cost savings.
- Quicker concrete truck turn-around times, enabling the producer to service the project more efficiently.
- Reduction or elimination of vibrator noise, potentially increasing construction hours in urban areas.
- Minimizes movement of ready mixed trucks and pumps during placement.
- Increased jobsite safety by eliminating the need for consolidation.
- Will increase overall productivity.



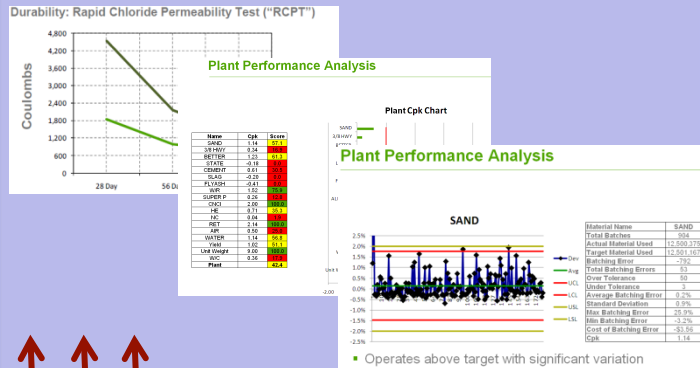
# Excellcrete SCC

- No need for powder additions.
- No need for high cement contents.
- Use Bingham rheology approach to choice of admixtures.
- Provides spreads from 550 mm and up.
- Provide SCC mixes with aggregate up to 25 mm.
- Cheaper than the prevailing market price by about 20%.
- Wide range scale on strength from as low as 15MPa to a maximum of 100MPa, over that of the very limited 45-65MPa provided by other manufacturers.

# Excelicrete QMS System Overview

# QMS System Overview

# Excelicrete QMS



**( Probe - Detect  
Moisture %)**



## ( Batching Control System)



**( Data Storage)**



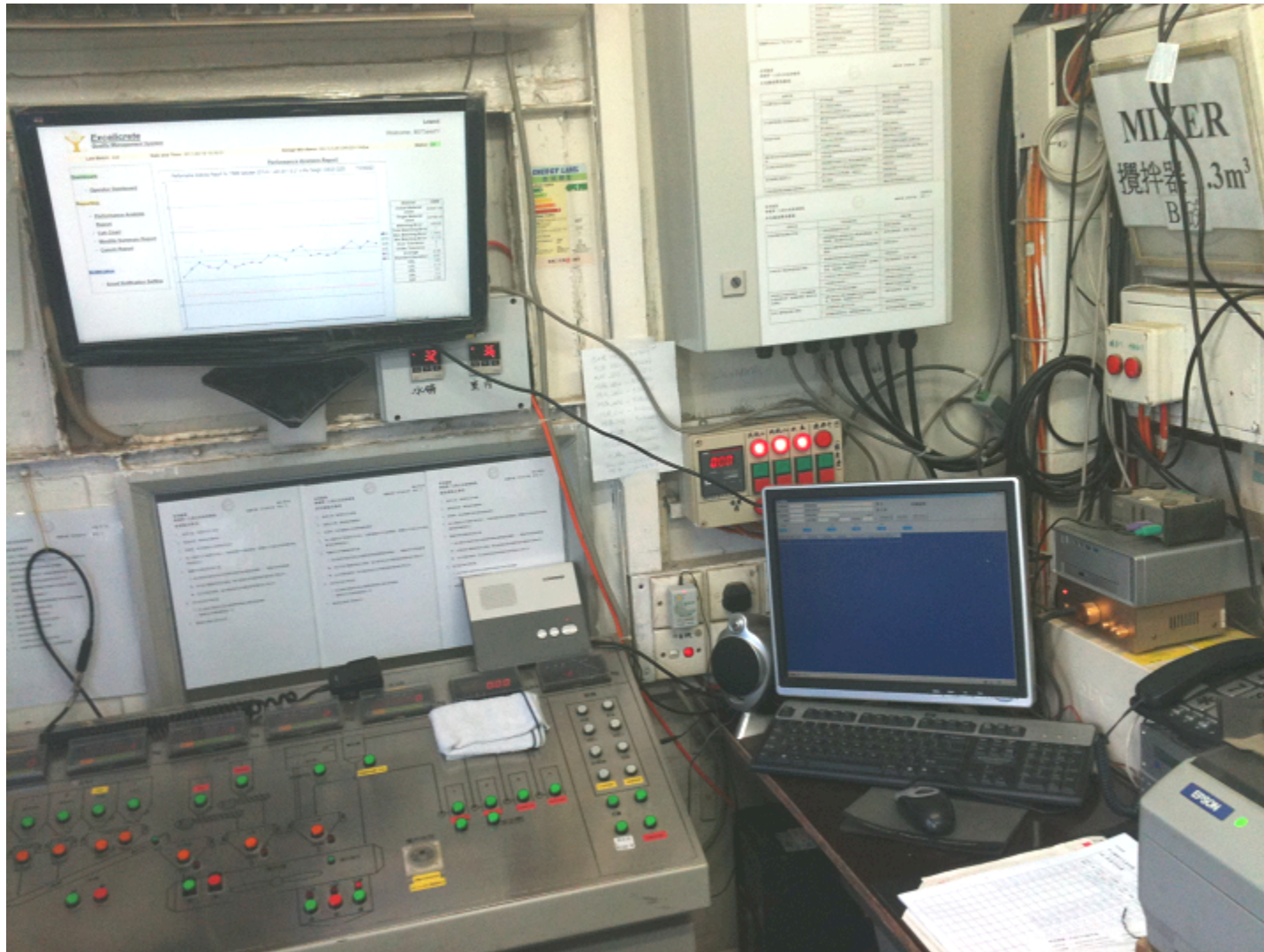
## Interfacing Data (Common Area)



## Excelicrete Link

# Internet

# Batching Plant Environment





# Excelicrete Link at Plant



# System Requirement

- **Software Requirement (Web base Solution)**

- Operation System : Windows XP (SP2) or above
- Internet Browser : IE 7.0 or above

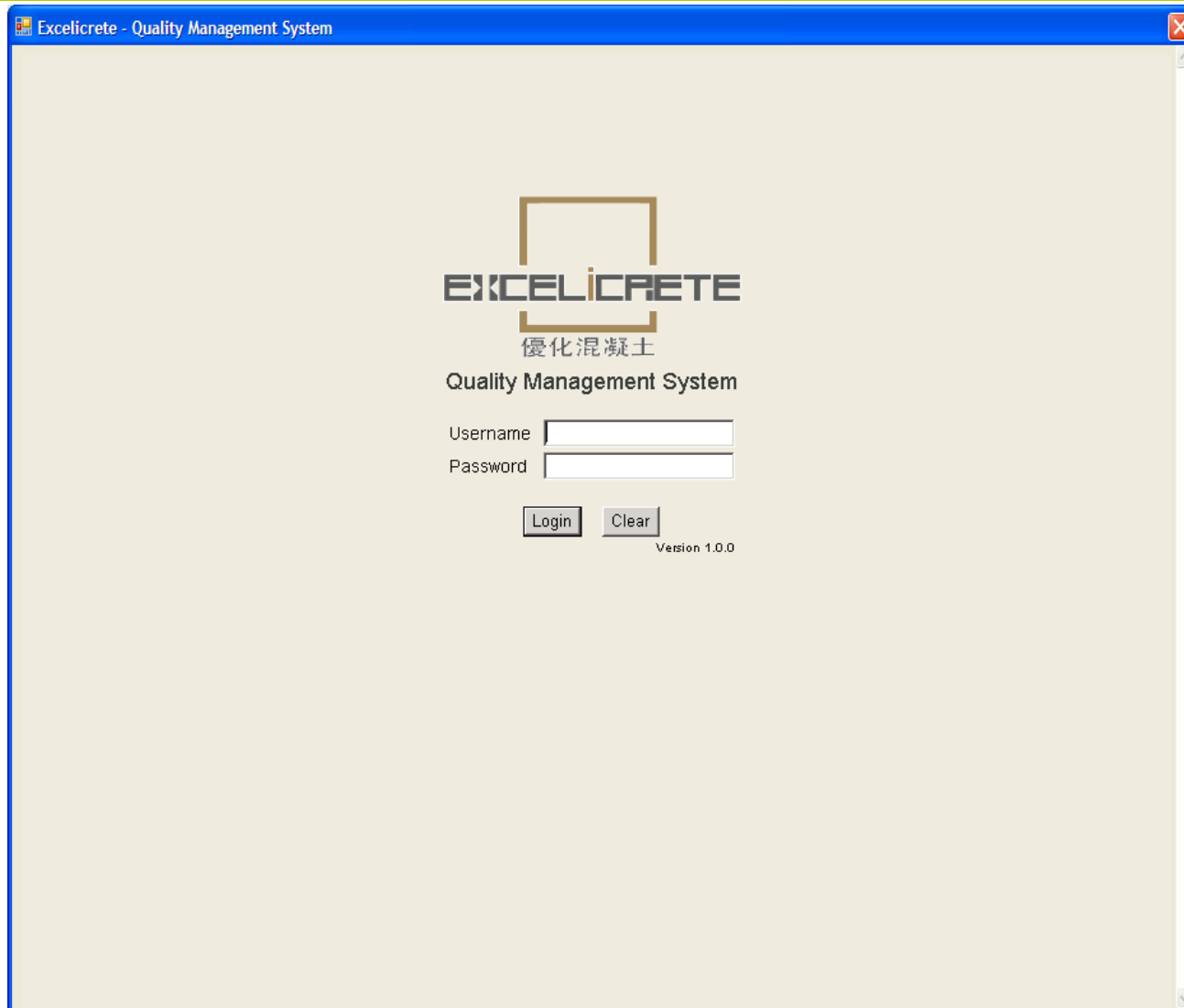
- **PC Hardware Requirement**

- Processor : Intel Core 2 Duo 2.4G or above
- Memory : 2G or above
- Hard disc : 160G or above

- **Internet Requirement for Excelicrete Link**

- Bandwidth : 2M/2M
- IP address : At least 1 Fixed IP Address
- Network Port : HTTP, HTTPS, DNS Service, DB Service

# Login Screen



The image shows a login screen for the 'Excelicrete - Quality Management System'. The window has a blue title bar with the text 'Excelicrete - Quality Management System' and a red close button. The main area has a light beige background. In the center, there is a logo consisting of a brown square frame with the word 'EXCELCRETE' in a bold, sans-serif font, where the 'i' is lowercase. Below the logo, the Chinese text '優化混凝土' (Optimized Concrete) is displayed, followed by 'Quality Management System'. Below this, there are two input fields: 'Username' and 'Password'. Under the 'Password' field are two buttons: 'Login' and 'Clear'. At the bottom right, the text 'Version 1.0.0' is visible.

Excelicrete - Quality Management System

EXCELCRETE  
優化混凝土  
Quality Management System

Username


Password

Login Clear

Version 1.0.0

# Dashboard for Operator

Excelicrete - Quality Management System



EXCELICRETE

優化混凝土

Quality Management System

Hide Menu

Change Password

Logout

Welcome, vhsupport !  
Current Plant: **KT1B\_1**

Last Batch: 4842

Date and Time: 2012-01-11 16:58:25

Design Mix Name: D35/20 D217 Y3235D011

Status: **OK**

Dashboard

- Operator Dashboard

Dashboard for Operator

Last Batch: 4842

Date and Time : 2012-01-11 16:58:25

Design Mix ID : D217

Design Mix Name : D35/20 D217 Y3235D011

Truck No : FW2862

Status : OK

Sales Volume (m³) : 1.00

Batching Details

Batch No	Time	Sales Volume (m³)	Status
1	2012-01-11 16:58:25	1.00	OK

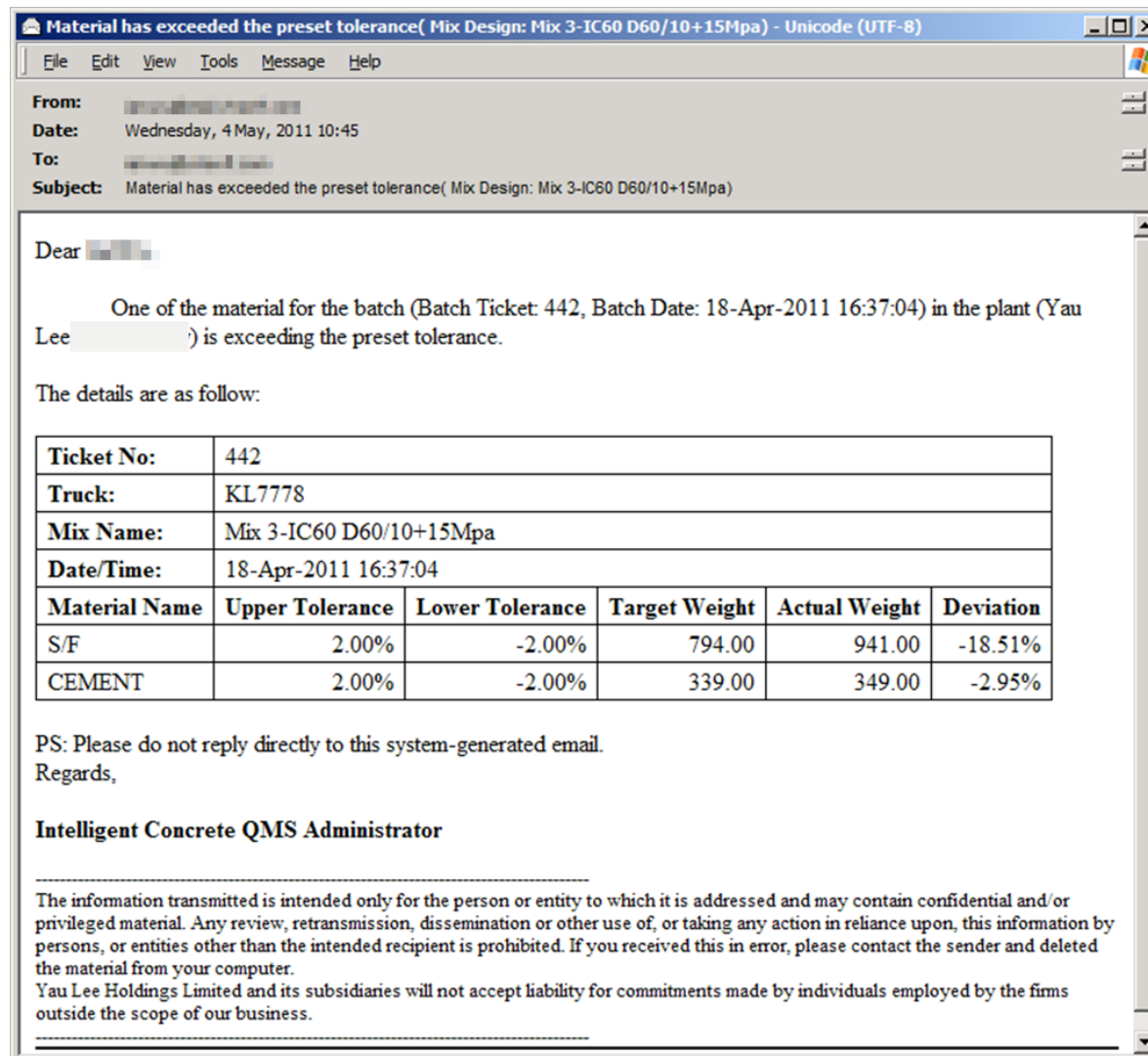
+ Material Batching Detail

Print

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# QMS Notification



# Dashboard for Management

## Dashboard

- Operator Dashboard
- Dashboard for HA
- Management Dashboard

## Dashboard for Management

FCU (MPa):

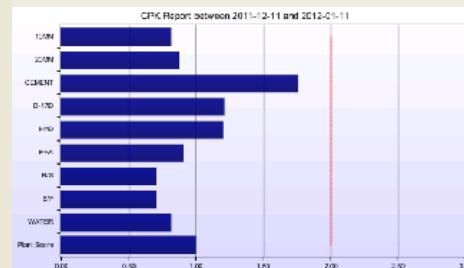
Data Range: ☐ Instant ☐ Last Day ☒ Last Month ☐ Last 3 Months ☐ Last 6 Months ☐ Year To Date

### Batching Summary

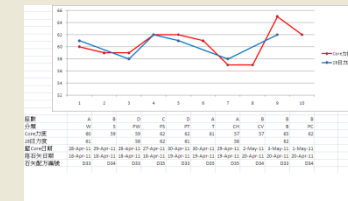
Period: 2011-12-11 to 2012-01-11

Design Mix Name	Design Mix ID	Production Volume (m <sup>3</sup> )		Cost of Batching Error	Standard Deviation of Batching Error	Average of Batching Error
		Produced	Disposed			
<a href="#">D60/200</a>	4344	5258	2	\$4,923	0.24	0.3
<a href="#">D60/120</a>	4377	8465	10	\$3,263	0.14	0.36
<a href="#">D46/100</a>	7534	1545	1	\$2,252	0.03	0.13
<a href="#">D45/120</a>	6724	586	0	\$125	0.2	0.13

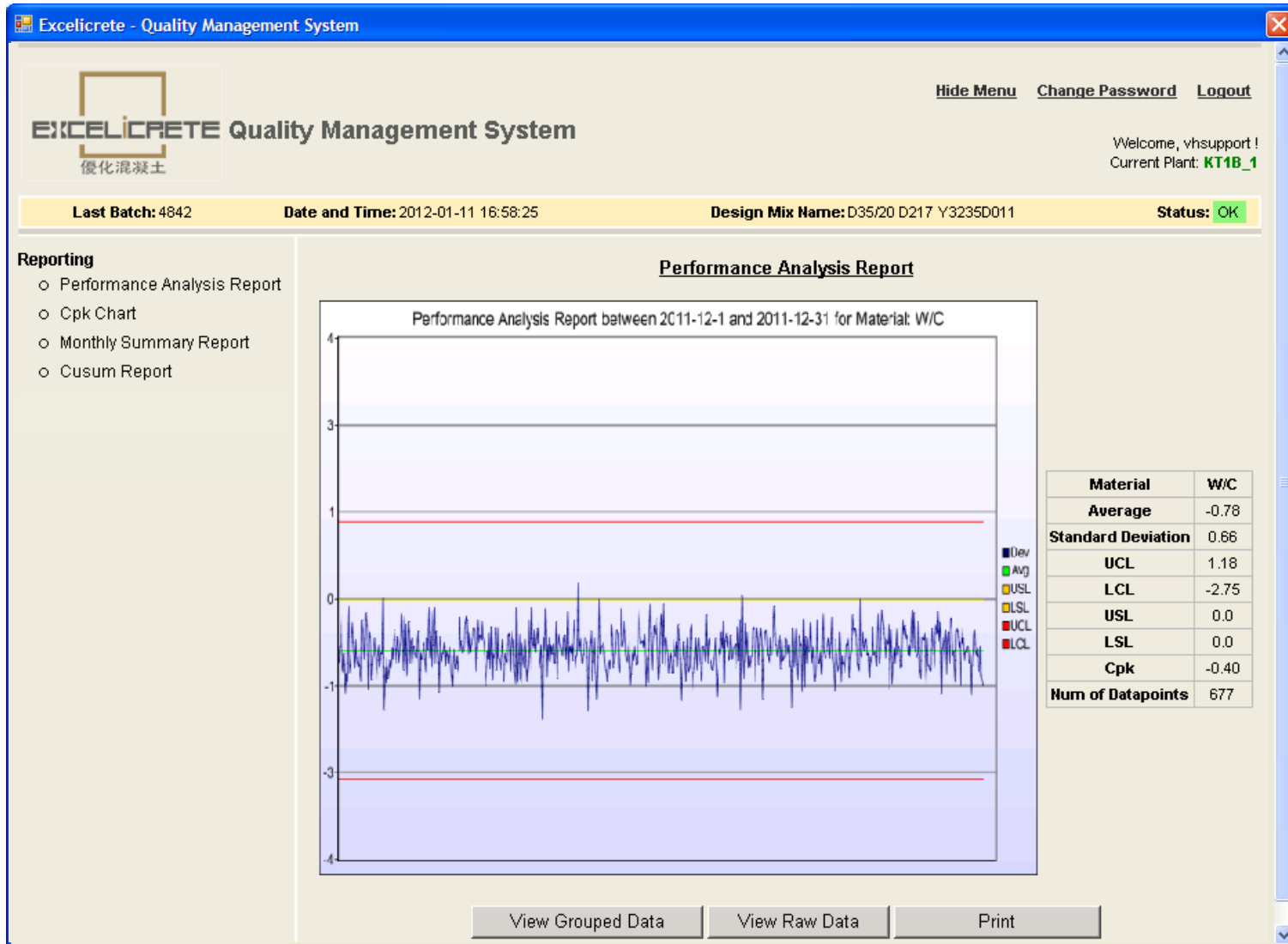
CPK Chart



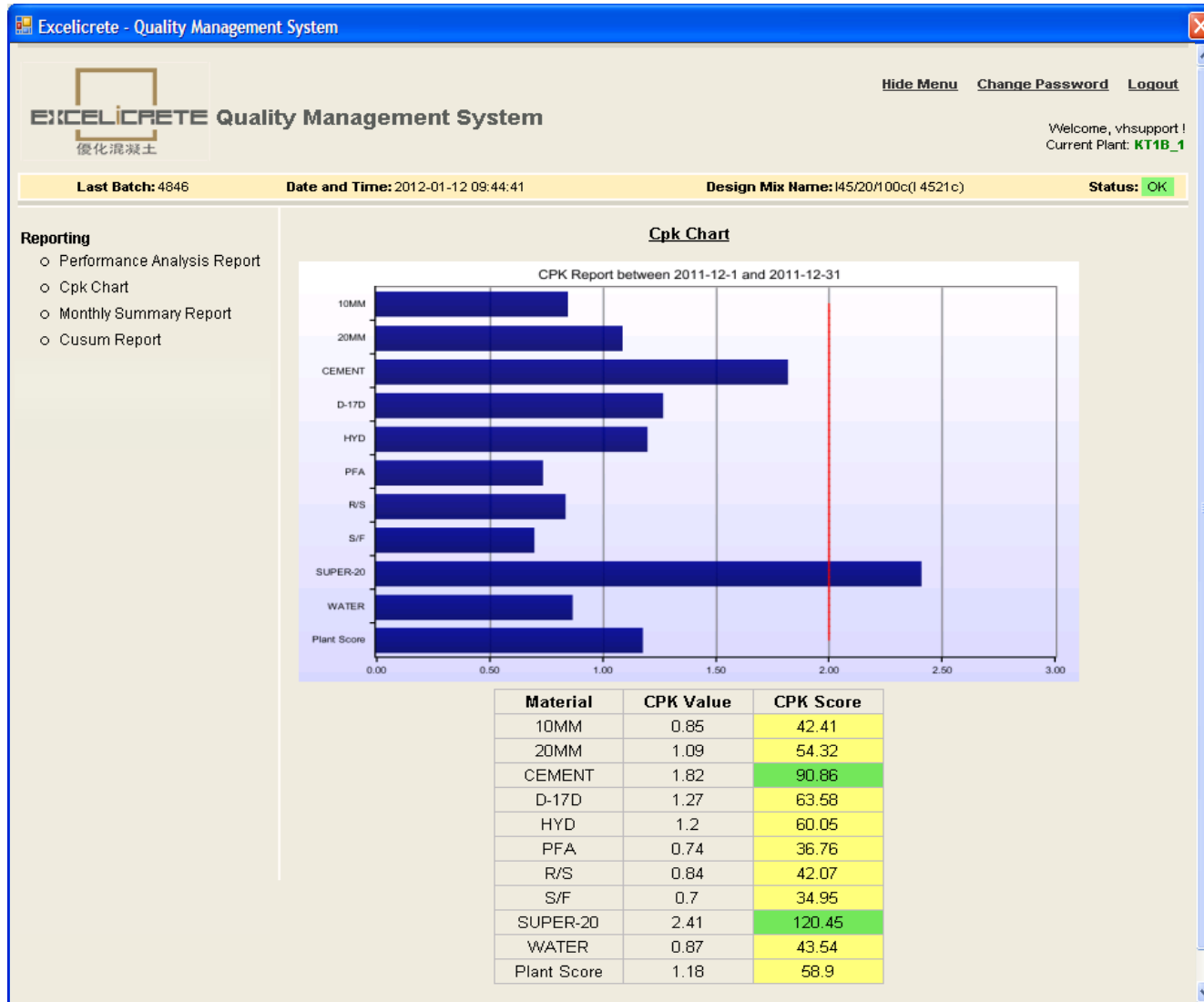
Strength



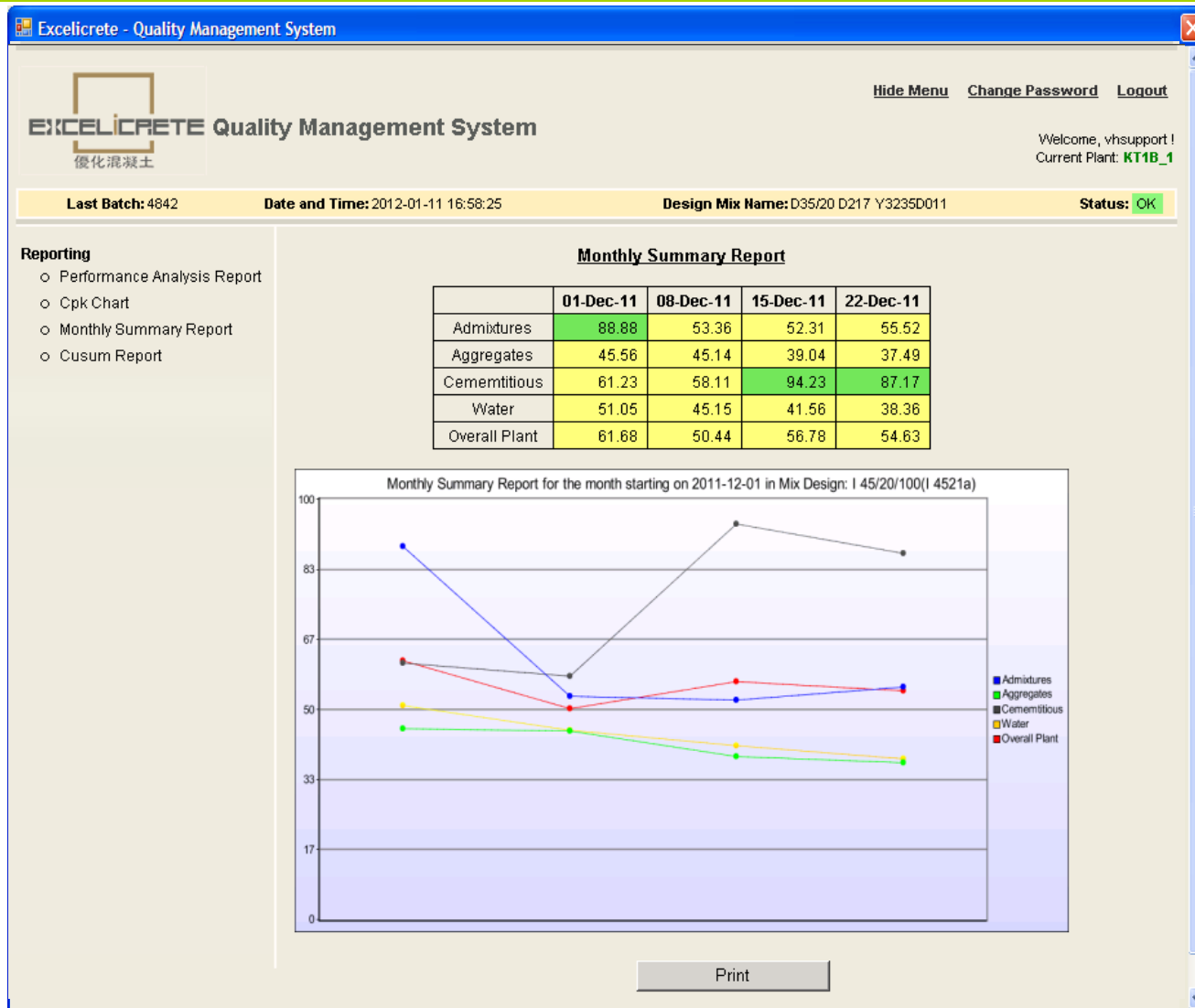
# Performance Analysis Report



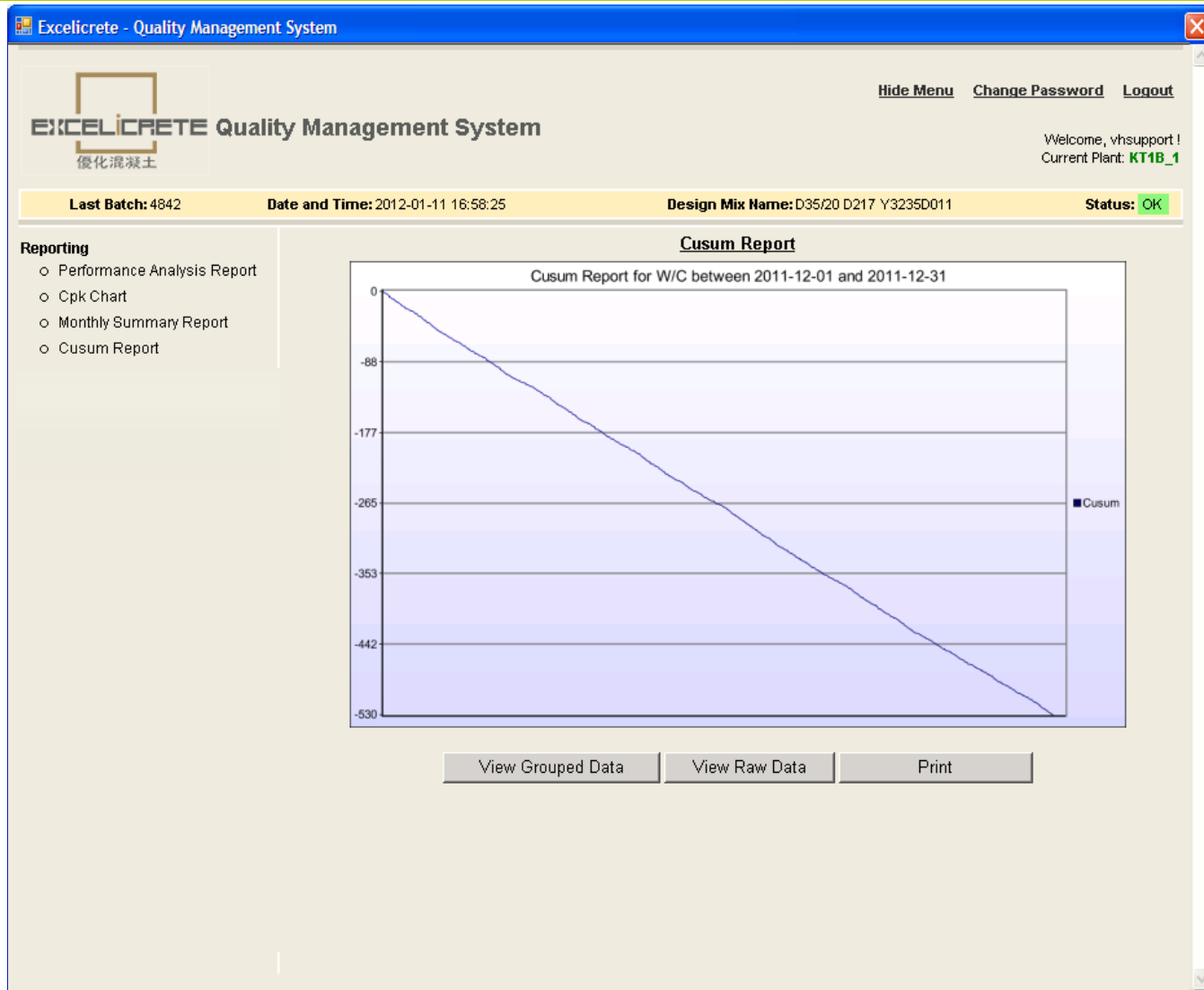
# CPK Chart



# Monthly Summary Report




# Cusum Report



# **Excelicrete QMS (SCC Module)**

# SCC Production Report

Excelicrete - Quality Management System

  
優化混凝土

Excelicrete Central Quality Management System

Hide Menu Change Password Logout

Welcome, vhsupport!

Reporting

- Production Report

Production Report (by Batching Plant)

Region: Hong Kong Company: Yau Lee Construction Company Limited Plant: KT1B\_1

Design Mix ID: ALL Design Mix Name: ALL

Period: 2012-01 To 2012-01

SCC Type: SCC Type Only

Cancel Print Report


Design Mix ID	Design Mix Name	SCC Type	Production Total (m³)
			2012-01
I6016	I60/10/SCC(I6016)	Yes	2.0
Summary:			2.0

Cancel Print Report



# Dashboard for Operator

Excelcrete - Quality Management System

  
優化混凝土

ExcelCRETE Quality Management System

[Hide Menu](#) [Change Password](#) [Logout](#)

Welcome, vhsupport!  
Current Plant: KT1B\_1

Last Batch: 4834

Date and Time: 2012-01-10 13:50:53

Design Mix Name: I60/10/SCC(I6016)

Status: OK

Dashboard

- Operator Dashboard

Dashboard for Operator

Last Batch: 4834

Design Mix ID : I6016 (SCC)

Truck No : HH4636

Sales Volume (m³) : 2.00

Date and Time : 2012-01-10 13:50:53

Design Mix Name : I60/10/SCC(I6016)

Status : OK

Batching Details

Batch No	Time	Sales Volume (m³)	Status
2	2012-01-10 13:50:53	1.00	OK
1	2012-01-10 13:44:32	1.00	OK

+ Material Batching Detail

Print

# QMS Analysis Reports

Last Batch: 4846

Date and Time: 2012-01-12 09:44:41

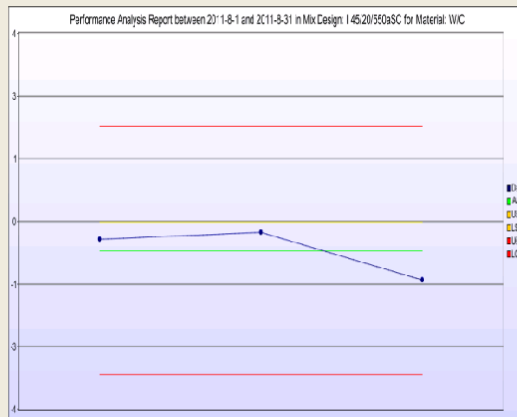
Design Mix Name: I45/20/100c(I 4521c)

Status: OK

## Reporting

- Performance Analysis Report
- Cpk Chart
- Monthly Summary Report
- Cusum Report

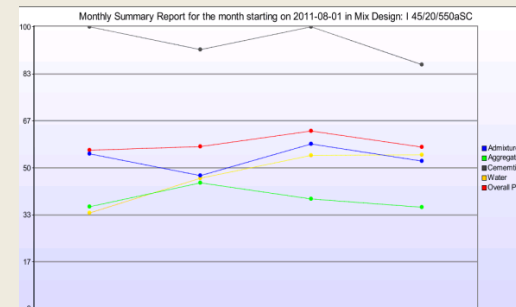
## Performance Analysis Report



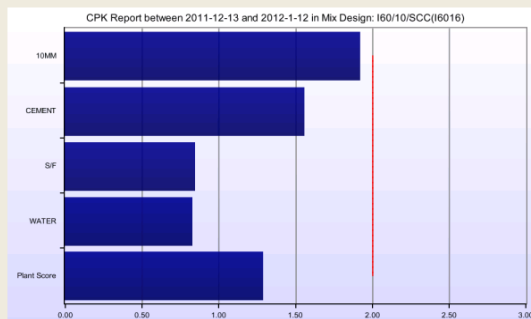
Material	W/C
Average	-0.61
Standard Deviation	0.88
UCL	2.02
LCL	-3.24
USL	0.0
LSL	0.0
Cpk	-0.23
Num of Datapoints	3

## Monthly Summary Report

	01-Aug-11	08-Aug-11	15-Aug-11	22-Aug-11
Admixtures	55.07	47.36	58.70	52.61
Aggregates	36.44	44.86	39.21	36.33
Cementitious	100.00	91.93	100.00	86.75
Water	34.20	46.54	54.68	54.72
Overall Plant	56.43	57.67	63.15	57.60

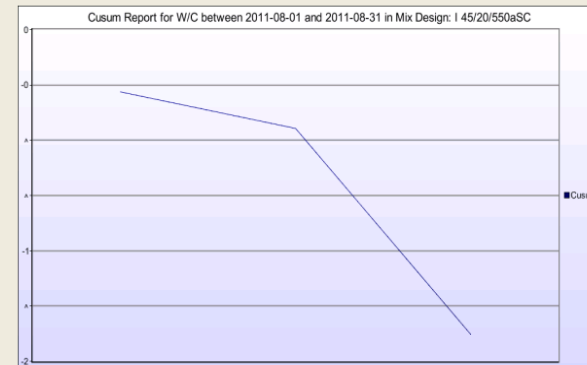


## Cpk Chart



Material	CPK Value	CPK Score
10MM	1.92	95.89
CEMENT	1.56	77.78
S/F	0.85	42.37
WATER	0.83	41.6
Plant Score	1.29	64.41

## Cusum Report



# Batching Plant System

# **Batching Plant System Interfacing Requirement**

# Batching Plant Data Interface

Batching Plant System

Excelicrete QMS System

Process

Action By

By Batch

1. Export batching data

Glorious

2. Generates MSSQL Database View

Glorious

3. Excelicrete Link captures batching data from database view to perform consolidation.

VHSoft

4. Excelicrete QMS shows alerts and generates Analysis Reports:

- Performance Report
- CPK Chart
- Monthly Summary
- Cusum Chart
- ....

VHSoft

Batching Plant Database

MSSQL Database View

QMS Database

Excelicrete QMS Alerts; CPK Chart; Performance Report etc.

Batching data:

- Ticket No
- Truck and Driver Name
- Mix Design ID / Name
- Load Date / Time
- Customer ID / Name
- Order No. / Quantity
- Aggregate Information (x5)
  - Name, Unit, Target Weight, Actual Weight and Moisture
- Cement Information (x3)
  - Name, Unit, Target Weight and Actual Weight
- Admixture Information (x6)
  - Name, Unit, Target Weight and Actual Weight
- Water Information (x2)
  - Name, Unit, Target Weight and Actual Weight

# Interface Requirement

## **QMS Interface Condition:**

- **Supports Max. Number of Material Selections per Material Type:**
  - Aggregate (Max. 20 Selections)
  - Cement (Max. 20 Selections)
  - Admixture (Max. 20 Selections)
  - Water (Max. 20 Selections)

# Green Technologies

**Think Green, Practice Green, Act Green**  
**Aim to provide a green living to our society.**

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**Thank You!**