

# **CEL 774 CONSTRUCTION PRACTISES**

*Acceptance & Quality Control*

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# ***General Outline***

- **Quality, its measure & sources of variation**
- **Acceptance criteria and implications**
- **Quality management of concrete at site or plant**
- **Role of in-situ testing**



# WHAT IS QUALITY? HOW'S IT MEASURED?

- The totality of features or characteristics of the product that bears on its ability to satisfy stated or implied needs.*
- Characteristics of the concrete those satisfy the needs are the properties at fresh and hardened states*
- Most commonly 28 day compressive strength is used to judge the quality of concrete.*



# WHAT IS QUALITY? HOW'S IT MEASURED?

- **No production process is so perfect that all the products are completely alike, concrete is no exception.**
- **There are large number of small uncontrollable factors those are responsible for variation from one lot to other and are regarded as chance variation**
- **The purpose of quality control is to minimize this variation**



# **SOURCES OF CONTROLLABLE VARIATIONS**

- Variations in properties of materials***
- Variation in proportions, e.g. w/c***
- Variations due to mixing process***
- Variation in compaction quality***
- Besides there are some inherent variations can be controlled partially***



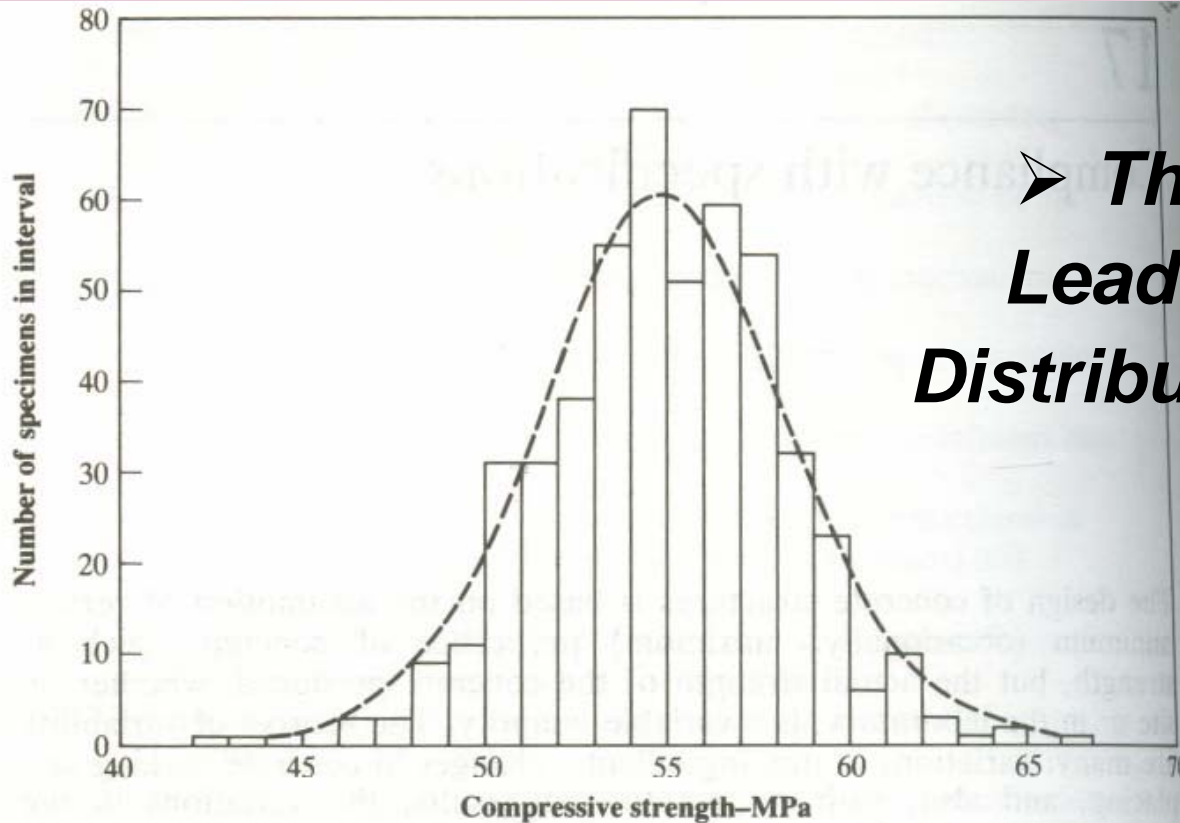
# Sampling

## 3 specimens in a sample

Volume of work	No of samples
1-5 m <sup>3</sup>	1
6-15 m <sup>3</sup>	2
16-30 m <sup>3</sup>	3
31-50 m <sup>3</sup>	4
>50 m <sup>3</sup>	4+1 per additional 50



# NATURE OF VARIATIONS

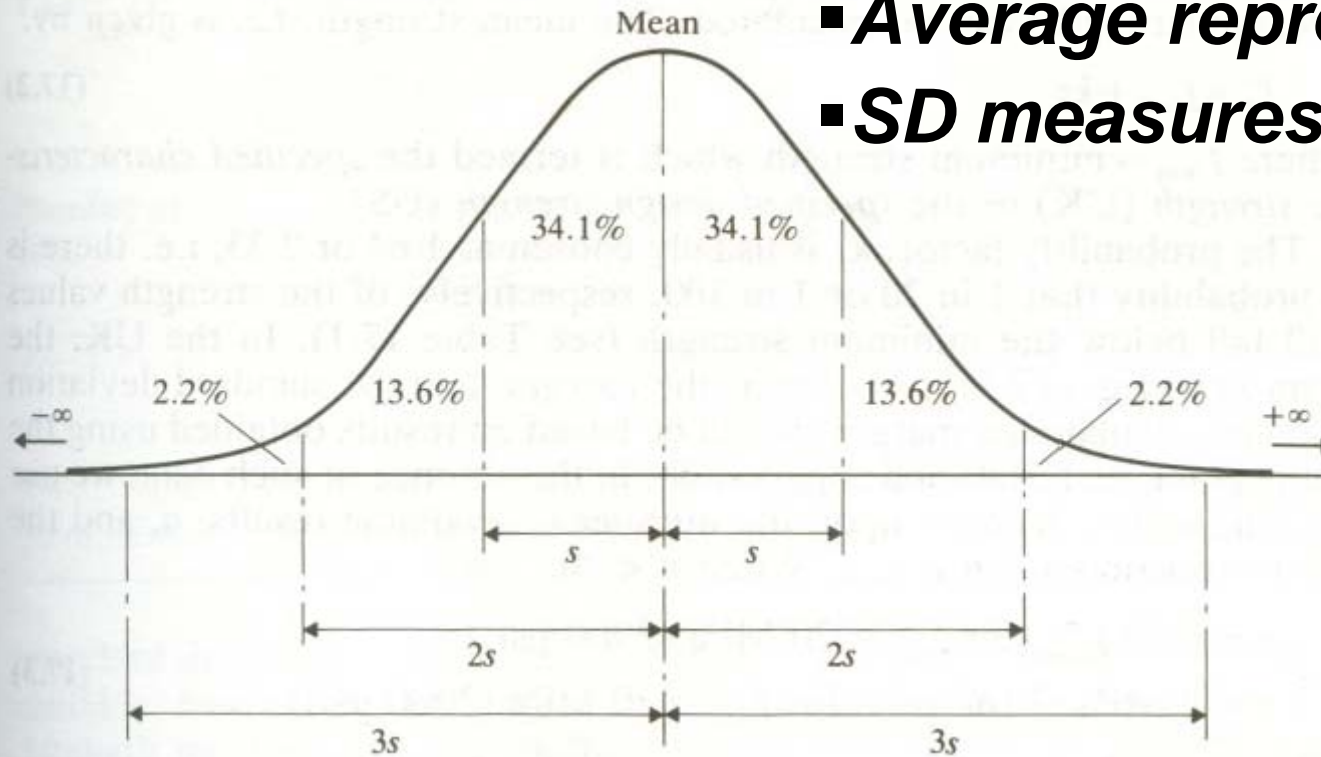


➤ **The variations  
Leads a normally  
Distributed population**



# NATURE OF VARIATIONS

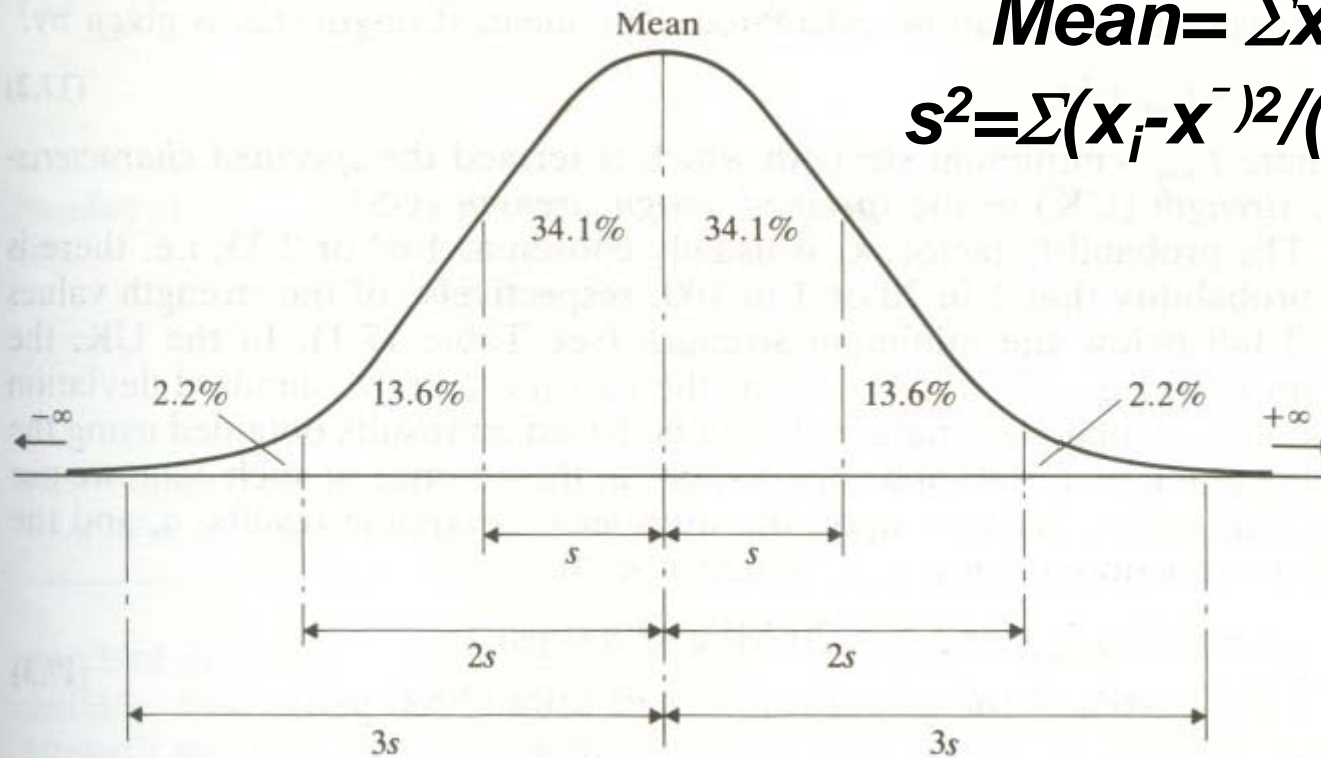
- **Average represents mean**
- **SD measures dispersion**



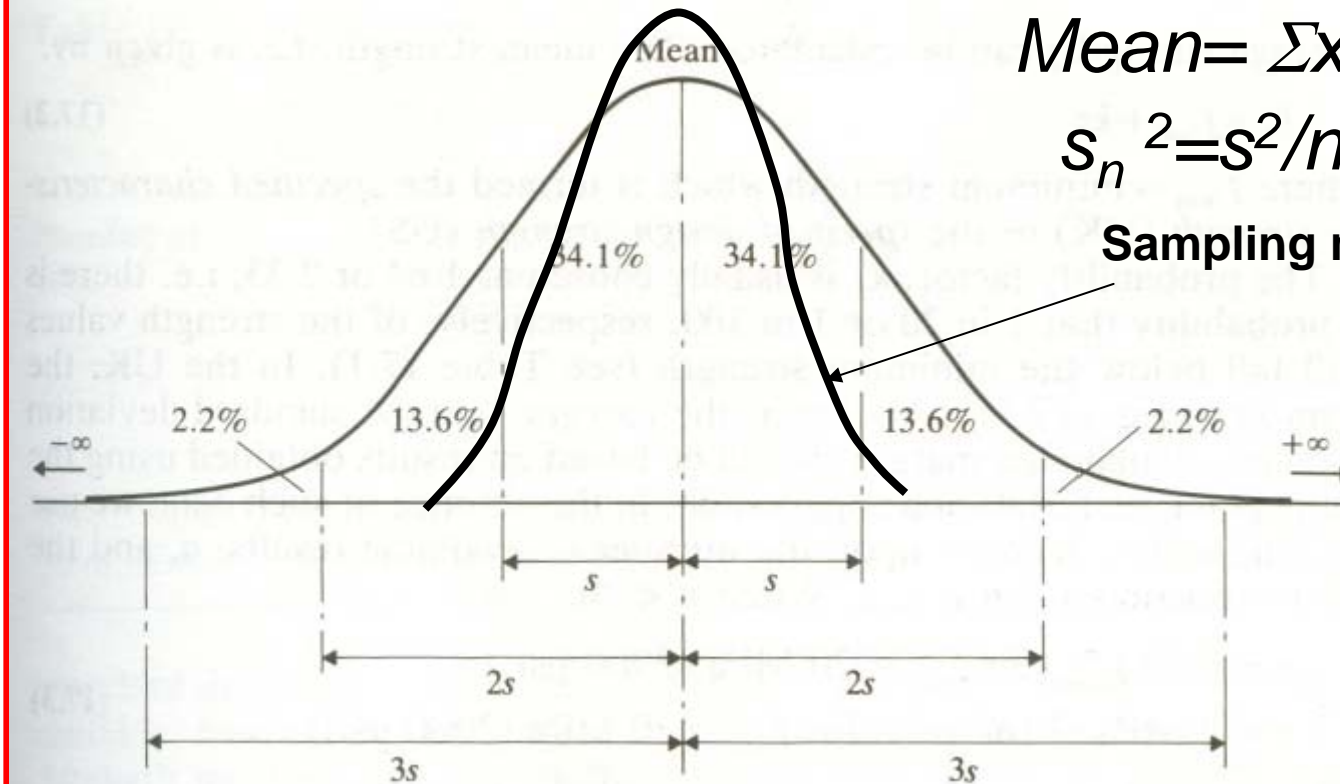


# NATURE OF VARIATIONS

$$\text{Mean} = \frac{\sum x}{n}$$
$$s^2 = \frac{\sum (x_i - \bar{x})^2}{(n-1)}$$



# DISTRIBUTION OF SAMPLING MEANS



$$\text{Mean} = \Sigma x/n$$

$$s_n^2 = s^2/n$$

Sampling mean distribution



# ACCEPTANCE

$$f_m = f_{ck} + 1.65\sigma$$

**Mean of group of 4 non-overlapping consecutive samples**

**$f_m$  (for 4 samples)  $\geq$**

**Max ( $f_{ck} + 0.825\sigma$ ,  $f_{ck} + 3$ ) for M15 grade**

**& Max ( $f_{ck} + 0.825\sigma$ ,  $f_{ck} + 4$ ) for M20 or higher grade**



# ACCEPTANCE

***Individual test results shall be greater than***

***$f_c \geq f_{ck} - 3 \text{ MPa}$  for M15 grade***

***and  $f_{ck} - 4 \text{ MPa}$  for M20 & higher grades***



# ACCEPTANCE

***Example problem: Following results are obtained for M25 concrete, check the acceptability  $\sigma = 5$ ;  
22,27,29,30,26,25,24***

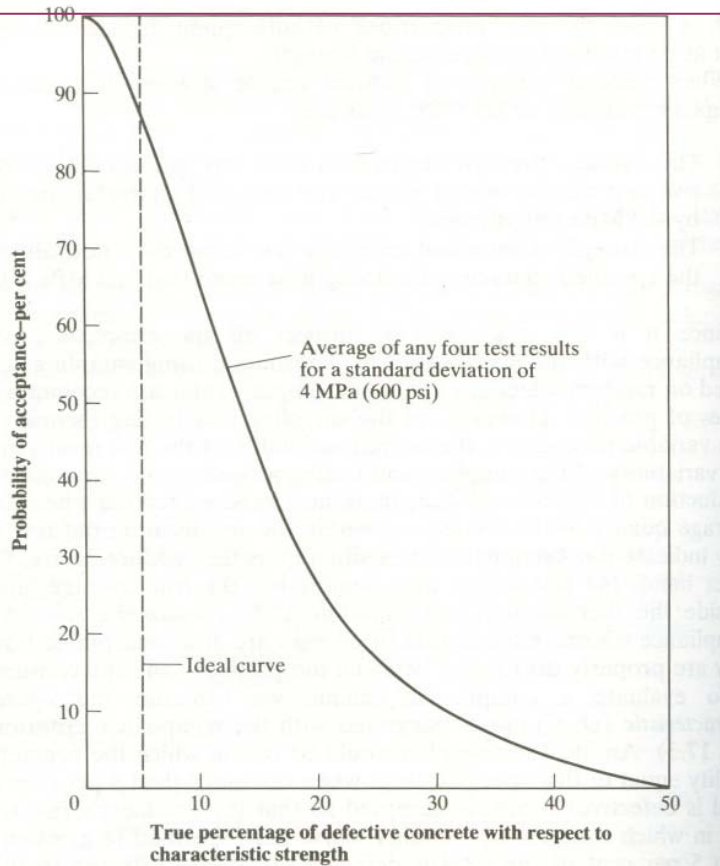


# ***Components of SD for concrete strength***

Cement	2.5 MPa
Aggregates	2MPa
Sampling & Testing	2MPa
Production	2.5MPa
Overall	4.5MPa



# ACCEPTANCE



## ❖ OC Curve for RMC

$$p = \frac{\binom{Nd}{0} \binom{N(1-d)}{n} \cdots \binom{Nd}{n} \binom{N(1-d)}{n}}{\binom{N}{n}}$$

$$f_m = f_{ck} + 2\sigma$$



# ***Summary***

***Definitations***

***Acceptance criteria***



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***THANK YOU FOR  
HEARING***



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