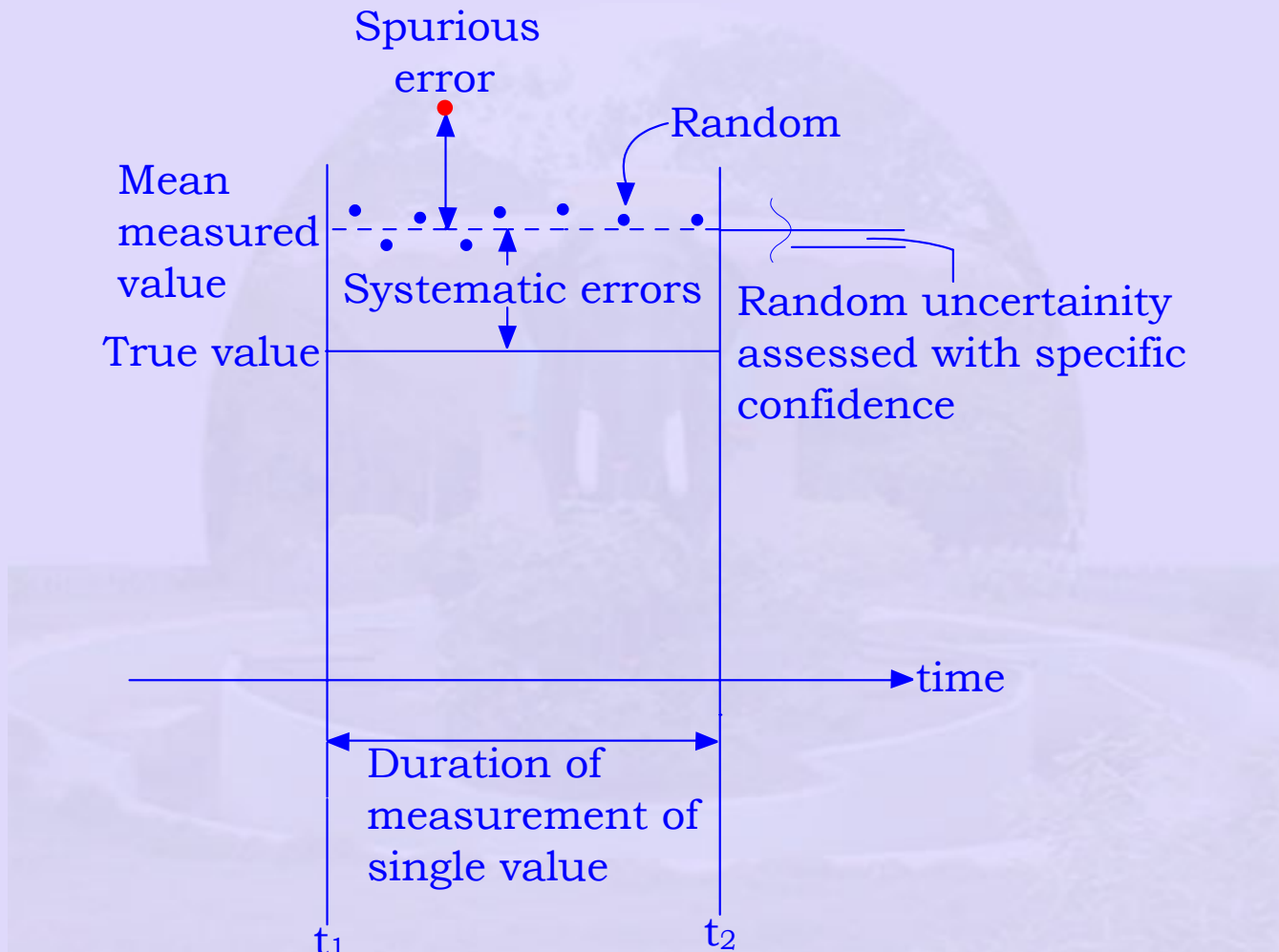


## 15.5 Errors in Measurements

Errors in measurements are now referred as Uncertainties in measurements.

There are three types of errors which must be considered

- Spurious errors (human mistakes and instrument malfunctions)
- Random errors (experimental and reading errors)
- Systematic errors (which may be either constant or variable).



Spurious errors are errors which invalidate a measurement. They are like outliers. They cannot be incorporated into a statistical analysis.

Random errors are error that affects the reproducibility of measurement. The mean random error of a summarized discharge over a period is expected to decrease when the number of discharge measurements during the period increases. Mean random error approaches zero over a long period of measurement.

Systematic errors are errors which cannot be reduced by increasing the number of measurements. Whenever there is an evidence of a systematic error of a known sign, the mean error should be added or subtracted from the measured results.

### 15.5.1 Sources of errors

Consider discharge equation  $Q = W C_d C_v f \sqrt{g} b h_1^n$  in which  $W$  and  $n$  are constants.

The different errors are

- The error in product of  $C_d C_v$ .
- The error in submerged flow reduction factor.
- Error in width or angle (dimensional measurement).
- Error in measurement of  $h_1$  or  $\Delta h$ .

It may be noted that the product is  $C_d C_v$  also a function of  $h_1$ . However the influence of  $h_1$  on  $C_d$  and  $C_v$  is small and hence can be neglected.

The error in measurement of  $h_1$  (or  $\Delta h$ ) can be divided into random part and systematic part of the error.

Possible sources of these contributory errors are

- Internal friction of the recording system.
- Inertia of the indication mechanism.
- Instrument error.
- Setting of the structure causing changes in dimensions and asymmetry, change in levels.
- The crest not being level (zero setting) in view of the poor construction. There may be other errors caused due to construction.
- Reading and recording errors.

The overall error in the flow  $Q$  is the resultant of various contributory errors which themselves may be composite errors. The propagation of errors depends on the standard deviation  $\sigma$ . Error analysis has to be carried out. Often there is tendency to over look a underestimate this.

**Reference:**

1. Bureau of Indian Standards 14,371, 1966.
2. Boss M.G. (Ed) Discharge Measurement Structure, Oxford and IBH Publishing Company, New-Delhi, India, 1975.

