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**Free Discussion** / Discussion libre / Freie Diskussion

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In the field of reinforced concrete, statistics of unit strength are available from laboratory tests and can be used to calculate the probability of failure of a structure made of identical material. The possible differences between site concrete and laboratory test specimens, however, are so unpredictable that the probability of failure of a structure may lie between, say, $10^{-6}$ and $10^{-3}$, according to the reliability of the construction supervisor, and many other factors appertaining to the site. Laboratory statistics, however, are useful for calculating and comparing safety factor values for various materials, assuming appropriate statistical distributions and the same probability of failure, as a basic criterion.

From investigations of failures, it appears that the coincidence of extreme weakness and overload, according to typical statistical distributions, never seems to occur. The cause of failure is always a definite fault, such as omission of reinforcement or serious overload. Present safety factor values, used in design in conjunction with good site control, are therefore satisfactory and will continue to avoid the, say, 1 in $10^{-6}$ hypothetical failure, which appears at first to be statistically inevitable. In the case of concrete, good site control is practised by limiting deviations of strength in concrete at the mixer and by the rejection, at critical sections, of the structure of any material weaker than, say, 85 per cent of characteristic strength.

The difference in philosophy of the laboratory engineer and site supervisor may be reconciled by recognising that safety depends on a double line of defence, viz. control within specified limits at the mixer and the rejection of weak material at critical sections. In addition, overload tests are necessary, when there is uncertainty.

There is sometimes an inconsistency in codes of practice between principles of safety defined in terms of "acceptable probability of failure" and construction requirements, to ensure the rejection of weak material.

Comparing the statistics of road accidents and their inevitability to building failures is to be deprecated. Young structural engineers are in danger of accepting failures as statistically inevitable and alleviating the contractor of his responsibility to reject weak material and apply test loads, where there is doubt.

Margins of safety, as defined by Safety Factor values, must be sufficient to result in weak material and overloading being fairly obvious. The tails of the strength and load histograms for the structure are then hypothetically cut off, unless there is incompetence or irresponsibility and the probability of failure is virtually reduced to zero.