Comments by the author of the introductory report

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Comments by the author of the introductory report
Remarques de l'auteur du rapport introductif
Bemerkungen des Verfassers des Einführungsberichtes

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Firstly may I comment on the prepared discussion which was introduced by the various authors.

1. RODIN & CHANON - This paper highlights those aspects which have become apparent in high rise domestic buildings due to the explosion hazard. The risk figures given by the authors supplement those given in my report. I must comment on the phrase "Progressive Collapse" which has been widely mis-used in this country; in my view collapse can be precisely defined and the use of adjectives only confuses one's thinking. We must accept that collapse is initiated somewhere and our task as designers is to provide an adequate probability against collapse be it sudden, gentle, incremental, explosive, or - as in most cases - hypothetical. The paper gives a sound engineering appraisal of the explosion hazard and its treatment in design.

2. ANG - This paper is an excellent example of the adaptation of the classical reliability approach to the limit state concept. It indicates a basis for detailed studies by Codes of Practice Committees and other regulating authorities to derive a consistent set of safety factors for different structural types.

3. LIGTENBERG - The data presented on failures in Holland in one year are of considerable interest. Further the author rightly emphasises the significance of many factors which have a greater frequency of occurrence in a modern society than perhaps has been accepted in the past. This paper also highlights the need to consider the total cost arising from failure since it should have a significant bearing on all the safety requirements not only those relating to the structure.

4. RAVINDRA, HEANEY & LIND - This is a further discussion of the derivation of partial safety factors in the limit state approach from the distribution functions of the various parameters and, in some ways, might be called a revised version of the approach postulated in 1955 by the Institution of Structural Engineers' committee on Structural Safety. It also gives some justification for the separation of the various parameters affecting safety that is inherent in the limit state approach discussed in my report.

5. SHINOZUKA - The application of information from proof loading tests, if not of entire structures at least of structural components, in rationalizing the safety concept is certainly deserving of study. This means of truncating the assumed distributions may well have some merit in specialized circumstances although it is difficult to reconcile proof tests with the vast majority of construction.

6. PALOHEIMO - This is a treatment of the combination of frequency functions for the parameters governing the behaviour of structural sections, and is achieved by the introduction of a generalized frequency function having sufficient accuracy for practical purposes. This report is really of work in the broad field of structural safety to assist in the definition of partial safety factors in a more rational manner.

7. HERTZOG - Partial safety factors are suggested for the various aspects considered by a designer; these are based on the author's earlier papers.

Now may I turn to the discussion on the various prepared discussions and on the theme of this session in general. Monsieur Lorin indicated that in applying the limit state approach to steel structures consideration should be given to the partial safety factors for materials and loads when the design approach relies on empirical equations, derived from test data. In particular, he suggested that the γ_m value should be taken as unity in certain circumstances. I believe that this approach is a valid one provided the experimental data really justify it. Mr Baker will be presenting some data on the variability of rolled steel joists which will indicate that a γ_m value greater than unity is required. Dr Tichy considered the multi-dimensional loading case on structural sections; this I regard as a necessary research exercise but before its use in practice is possible considerable simplifications will have to be introduced which relate this complex case to the more normal cases dealt with in the majority of design calculations. Dr Viest amplified some of the points made in Mr Fox's printed report and made two pleas - one for simplicity in codifying limit state procedures, which I endorse, and the other for greater attention to be paid to probability theory in undergraduate courses. This leads me to say "Heaven Forbid! " - I would prefer that more attention should be devoted to a discussion of the parameters governing structural safety and then introducing probability only in so far as is necessary.

Mr Weinberg's comment that the removal of gas seems a simple engineering solution to the problems posed in the prepared discussion by Rodin and Chanon is welcome although it has been said often before in this country. This represents what I term the overall appraisal of the safety problem with the necessary action, structural or otherwise, taken to achieve the desired degree of safety.

Madame Manuzio emphasised that the strict probability approach has already been applied in Italy to the design of transmission towers. This indicates that, given the necessary basic data, the limit state approach can be applied rigorously with considerable economic benefit.

To summarize this session, I think it is generally accepted that the concept of safety can only be based upon a probability approach, that the levels of risks which are acceptable must be specified, either implicitly or explicitly, by Regulating Authorities and that there is a need to reduce the complexities inherently associated with probability theory, so that the codification of design approaches is appropriate for the needs of the designer. The limit state approach seems to offer the best means of reconciling the two conflicting requirements. On the one hand there is the desire to treat safety in the logical way using probability theory and, on the other, the need for relative simplicity in the design procedure. I believe that, in future, the application of probability theory and computer simulation studies will temper the partial safety factors associated with the limit state approach and hence the reconciliation will be achieved.

Finally, may I attempt to define some areas for future study arising from my own report and the prepared and general discussion. These are:

(i) the derivation of sound statistical data on loads (of all types) on structures;

(ii) the assessment of acceptable risk levels for defined "failure criteria" in all types of structures;

(iii) an assessment of the variability of structures as built and its significance on the overall structural behaviour;

(iv) the derivation of simple design procedures yielding the desired structural safety with the maximum economy in design effort.