

# Free discussion

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Objektyp: **Article**

Zeitschrift: **IABSE reports of the working commissions = Rapports des commissions de travail AIPC = IVBH Berichte der Arbeitskommissionen**

Band (Jahr): **4 (1969)**

PDF erstellt am: **12.07.2024**

Persistenter Link: <https://doi.org/10.5169/seals-5959>

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I would draw your attention to the following:-

Army barrack buildings at Aldershot, Steel frame building in construction at Edinburgh, Staircase in multi-storey block of flats at Isleworth, Restaurant floor in Spain, Ferrybridge cooling towers, Ronan Point and many others.

Some of these disasters have been horrifying and I hope all have been disturbing to those assembled here. I am surprised that a theme was not introduced at this conference examining such failures. I ask you to consider carefully how many of these disasters would have been prevented had this symposium taken place before their occurrence. I suggest to you regretfully that the answer is very few.

The task of the practising engineer is to design structures with economy and an acceptable degree of safety. We do not always succeed - why? Perhaps we have taken insufficient account of variability of materials, workmanship, and loads (gravity, wind temperature etc.), or the inadequacy of design methods. These factors can to a greater or lesser degree be dealt with by probabalistic methods and it is encouraging to see so much research going on in this field.

In practice however, failures are more often due to mistakes, negligence, lack of knowledge, poor communications or inadequate control and supervision of the work. We must therefore take a broader view of the question of safety than that provided by probability theories alone.

If mistakes are to be reduced our methods of design must be simple, clear and easily checked with the principles clearly stated and understood. This is true whether a computer is used or not because a computer can make mistakes and wrong information can be fed in. The trend today is towards more elaborate design procedures consuming more of the engineers time and perhaps diverting attention from the more general aspects of safety. It is vital that if the ideas put forward in this conference are to be of real value in the design office then the principles must be clearly stated in broad terms and the detailed application must be reasonably simple and capable of easy checking otherwise the effect on safety may be adverse rather than beneficial.

The question of communication is becoming increasingly important with the increase in the size and complexity of projects and the numbers of different people involved. Many failures can be traced to poor communications between Architect and Client, Engineer and Client, Designer and Fabricator, Designer and Erector, and so on and it is essential to pay proper attention to this matter.

Negligence is not easy to deal with but penalties can be imposed and control procedures adopted which will help. Lack of knowledge can only be remedied by continuing research and feed back of information but despite our best endeavours and intentions there will continue to be instances of the unforeseen happening because of an inevitable degree of ignorance which will always be present.

It will be seen therefore that however much care we take it is not possible to eliminate the cause of failure entirely but we can frequently localise the affect by adopting 'fail safe' or 'alternative path designs' and this aspect should be considered at an early stage in the design.

At this conference great emphasis has been laid on the use of statistics and probability theories; while recognizing the value of these in helping to make our structures safer with economy I recommend to you that at least as much attention be given at a future conference on safety to the other important questions referred to above.