IVa

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**Partially Prestressed Concrete Bridges**

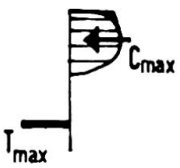
Ponts en béton partiellement précontraint

Teilweise vorgespannte Betonbrücken

P.W. ABELES

I note with great interest that Prof. Leonhardt states that in his view it would be "more correct" to base a bridge design "upon the live load which can be expected to occur a million times", for which the structure is in compression (i.e. fully prestressed). However, "no limit should be laid down for the magnitude of tensile stress or tensile strain occurring under the rare abnormal load" (see Fig. 1 of paper IVb (5) ). This is illustrated in the figure below. It

**MOST SUITABLE TYPE OF PRESTRESSED CONCRETE BEAM**

| LOADING | CLASS OF DESIGN | DESIGN CONSIDERATION | BEHAVIOUR |
|---|---|---|---|
| NORMAL SERVICE LOAD | CLASS I | HOMOGENEOUS SECTION :  NO TENSILE STRESS AT NORMAL SERVICE LOAD | RIGID AND FREE FROM CRACKS |
| ABNORMAL SERVICE LOAD | CLASS III | CAN BE IGNORED | DUCTILE WITH TEMPORARY FINE CRACKS |
| COLLAPSE LOAD | BASED ON ABNORMAL LOAD | CRACKED SECTION :   BASED ON ABNORMAL LOADING | — |

suffices to design the required prestressing force for the normal loading and the ultimate load for the abnormal loading, with the consequence of a completely rigid structure at normal loading and a ductile structure with temporary fine cracks at the rare abnormal load, which cracks close immediately on removal of the loads. Thus, this type combines classes I and III of the FIP-CEB classification, which I am calling in my contribution to the subject, IVb (5) class IIIA. I should like to refer to contribution IVb (6) relating to the tests at Duke University and may add that 2 abnormal loads per week amount only to 10,000 cycles in 100 years.

I have been able to assist in the introduction of a similar type, which is slightly less advanced, at bridge structures at the Chief Civil Engineering Department of British Railways, Eastern Region, twenty years ago. In this case similar conditions applied to the normal loading but the tensile stresses at the abnormal loading were limited so as not to cause visible cracking corresponding to nominal tensile stresses of 600 and later 650 psi. Many hundreds of road bridges of this type over railways were built between 1949 and 1962 and have remained without visible cracks, as inspections have shown.