Effect of prestress on the damping of concrete

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II

Effect of Prestress on the Damping of Concrete

Influence de la précontrainte sur le facteur d'amortissement des oscillations dans les structures en béton armé

Einfluss der Vorspannung auf die Dämpfung von Betonkonstruktionen

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In the Structural Research Laboratory at the Technical University of Denmark some tests were carried out in order to investigate the effect of prestress on the damping properties of concrete. The research project was carried out by P. Haurbæk under the supervision of C. Dyrbye. The test results have not yet been published. A brief description will be given in the following.

Three different types of tests were made:

In our 10 Mp high frequency Amsler pulsating machine (Fig. 1) 18 cm long concrete prisms with a 6 by 6 cm square cross section were subjected to oscillating compressive stresses.

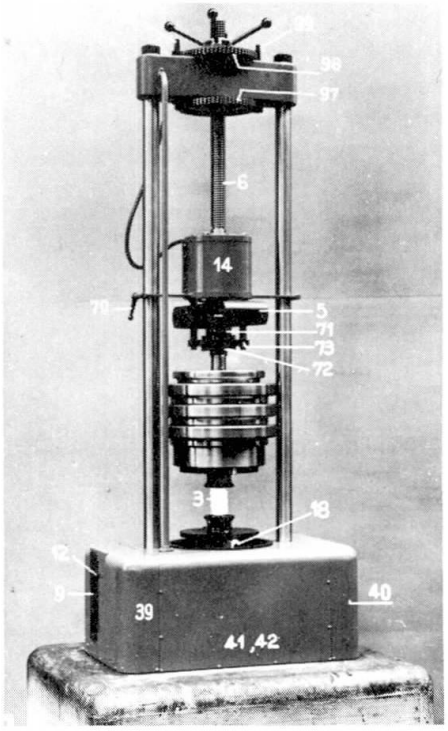


Fig. 1.

When the machine was stopped the free vibrations were gradually damped (Fig. 2). The relation between the imposed stresses and the damping is illustrated by the curves in Fig. 3. The ordinates indicate the damping

Fig. 2.

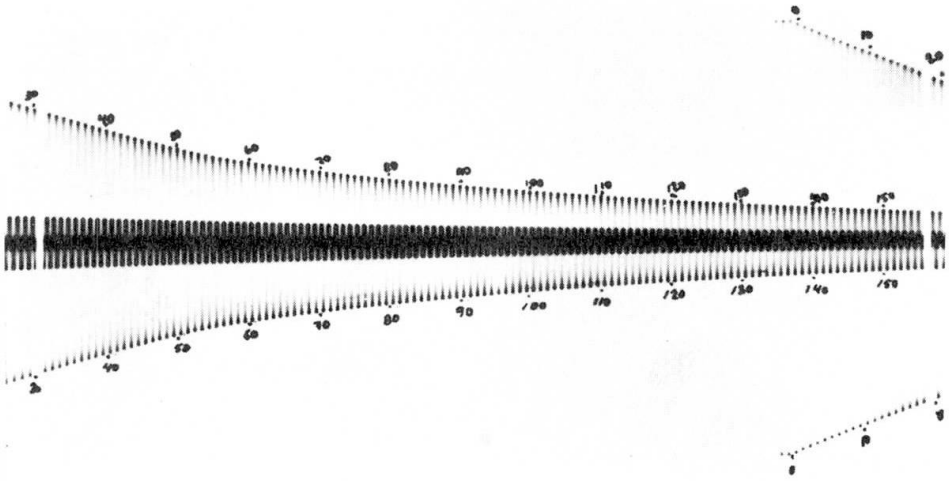
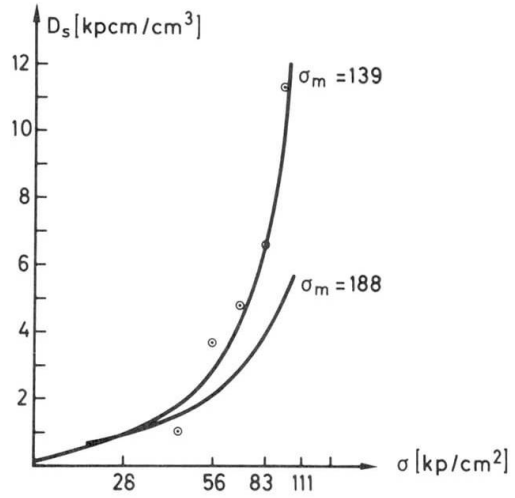


Fig. 3.



expressed by the dissipated energy per unit volume. The abscissas indicate the dynamic stress amplitudes. The average stress was 139 kp/cm^2 for the upper curve and 188 kp/cm^2 for the lower curve.

In the second test series 45 cm long concrete prisms with a 15 by 15 cm square cross section were tested in our low frequency Amsler testing machine (Fig. 4) and the damping of the forced vibrations was measured. The average stress was 139 kp/cm^2. The results correspond to the five points indicated in Fig. 3. Thus good agreement was found between the high and low frequency test.

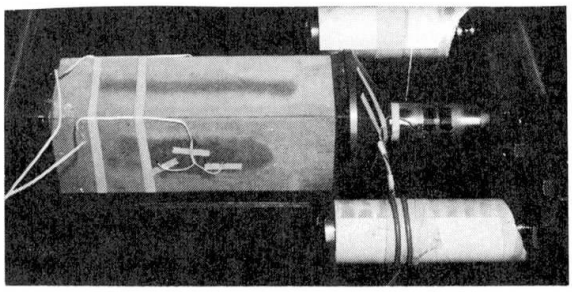
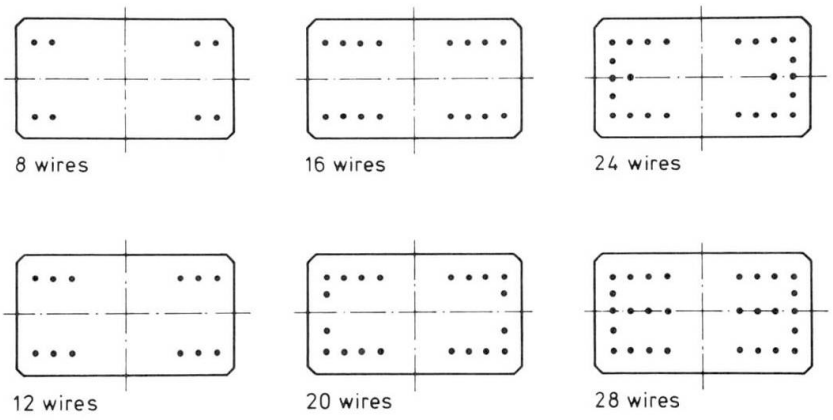


Fig. 4.

In the third test series twelve pretensioned beams were investgated. These beams were 6 meters long. The cross section had a depth of 13 cm and a width of 24 cm. The beams were identical with the only exception that six different levels of prestress were obtained by using different numbers of prestressing wires (Fig. 5). The beams were simply supported (see Figs. 6 and 7).

Fig. 5.



Cross sections of beams with different numbers of prestressing wires

Fig. 6.

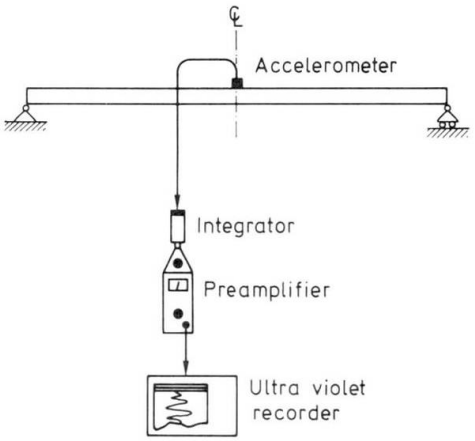
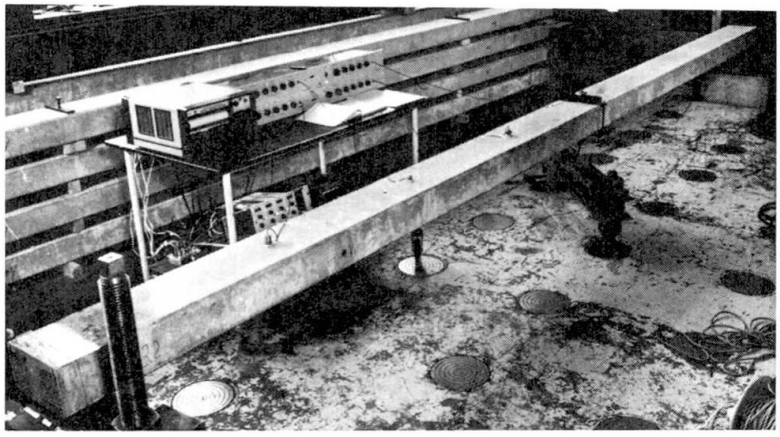


Fig. 7.



A static load was suddenly removed, and the ensuing vibrations were measured by means of an accelerometer (Figs. 6 and 8) and were recorded in diagrams as shown in Fig. 9. The damping characterized by the logarithmic decrement was calculated from these records. The results are illustrated in Fig. 10, where the abscissas indicate the dynamic stress amplitudes and the ordinates indicate the logarithmic decrement. The six curves represent the six different levels of prestress characterized by the number of prestressing wires. Except for the beams with 20 wires the results appear reasonable, but it has not been possible to give a satisfactory explanation of the apparent discrepancy of the results from the beams with 20 wires.

Fig. 8.

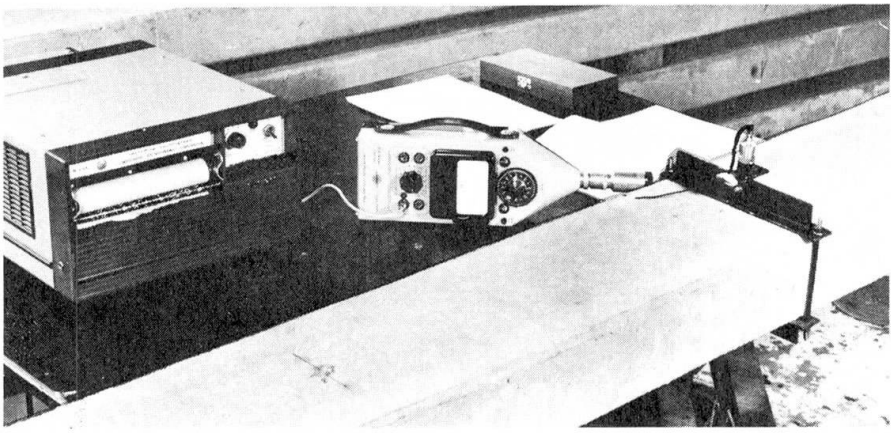


Fig. 9.

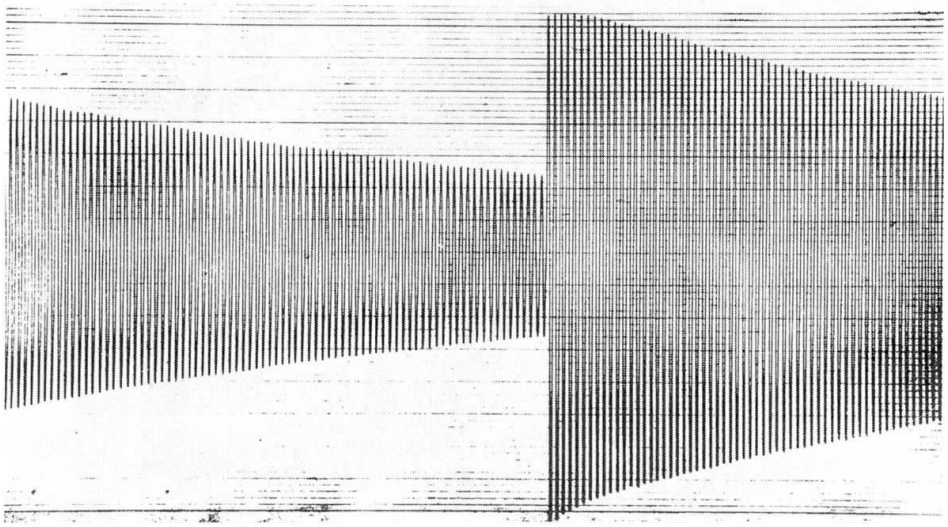
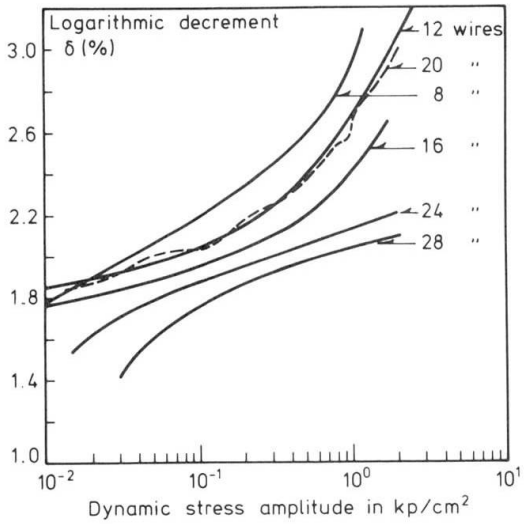


Fig. 10.



Conclusion.

The general tendency in all three test series is that the damping is reduced when the prestress is increased and when the stress amplitude is decreased.

SUMMARY

Test carried out at the Technical University of Denmark indicate that the damping of concrete structures is reduced when the prestress is increased and when the stress amplitude is decreased.

RESUME

Des essais effectués à l'Université Technique du Danemark montrent que le facteur d'amortissement des oscillations dans les structures en béton diminue avec l'augmentation de la précontrainte et avec la diminution de l'amplitude de contrainte.

ZUSAMMENFASSUNG

Versuche an der Technischen Hochschule Dänemarks zeigen, dass die Dämpfung von Betonkonstruktionen mit zunehmender Vorspannung und mit abnehmender Spannungsamplitude reduziert wird.

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