THE STRESSES IN BEAMS OF UNIFROM CROSS-SECTION UNDER DYANAMIC LOADING

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Abstract

This dissertation describes an investigation of the response of beams to suddenly applied loads, with particular reference to the effects of shear deflection and rotational inertia, and to the development of "wave solutions" as an alternative to the classical normal mode solutions. As the treatment is mainly theoretical, only beams of uniform cross-section have been considered. Damping caused by internal hysteresis, etc., has not been included as it is usually negligible.

A discussion of the methods of obtaining wave solutions, and of the fundamental equations on which the theoretical work is based, is given in the first part of the dissertation, and an approximate method of investigating the effects of shear deflection, etc. is proposed.

In the second part of the dissertation a method of solution in terms of normal modes is given, and particular examples are discussed. The convergence of the solution is shown to be unsatisfactory at values of time small compared with the fundamental period of the beam. The effect of shear deflection, etc. is examined for the simply supported beam.

In the third part of the dissertation the response of an infinite beam to a suddenly applied load is examined by means of operational methods, and effects of shear deflection, etc. are discussed. The operational method is then used to obtain wave solutions for finite beams with various end conditions, and it is shown that the wave expansion has good practical convergence at times small compared with the fundamental period of the beam. Solutions of numerical examples are obtained both by the normal mode method, and by the wave method, and are found to be in good agreement with experimental results.

An experimental apparatus is described which produces a dynamic load of the "suddenly applied force" type on a model structure by releasing the structure from a

deflection position. The apparatus displays, on a cathode-ray oscillograph with a time base synchronized with the release of the structure, a record of strain or velocity at a chosen measuring point. This apparatus is used with model beams to obtain results for comparison with those predicted by theory.