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SYMPOSIUM ON DETERMINATION OF ELASTIC CONSTANTS

INTRODUCTION

By Walter Ramberg[1]

There has, in recent years, been a revival of interest in the determination of elastic constants. This has been created in part by the availability of many new materials to the structural engineer and in part by the increasing emphasis on light weight, efficient structures designed to withstand dynamic loading over a wide range of temperatures. These considerations require not only a more accurate knowledge of the elastic constants already known and their extension to extreme temperatures, but also the development of techniques applicable to some of the newer materials such as the plastics and composite materials now in general use in aircraft and other structures.

It has been found, for example, that the conventional methods for determining elastic constants of metals under static loads with strain gages fail at elevated temperatures because of creep unless special precautions are taken. Dynamic methods are, therefore, usually resorted to for metals at elevated temperatures. They are often used for plastics at ordinary temperatures, since plastics will creep at much lower temperatures than most metals. In composite materials such as plastic laminates or plywood more than two elastic constants are required to connect stresses with strains, and the technique for determining these constants becomes correspondingly more complicated. Experimental stress analysis is now commonly indulged in, thanks to the introduction of the wire strain gage about ten years ago, and it has created a demand for a knowledge of Poisson's ratio as well as Young's modulus in order to convert strains into stresses on bodies, such as pressure vessels, that are in a two-dimensional rather than a uniaxial state of stress.

The present symposium was designed to review critically the various methods which have been developed for determining elastic constants and focus attention on those methods which might be considered ultimately for standardization by ASTM.

The symposium is opened by an analysis of returns from a questionnaire on the needs regarding elastic constants and on current practice in their determination. An ingenious static method for modulus determinations at elevated temperatures and its application to steels is described in the second paper. Static and dynamic methods for non-metals are surveyed in the third. Dynamic methods with their advantages and limitations are discussed in the fourth paper. The symposium is closed with a comparison of values of elastic constants for a beryllium-copper alloy obtained by several static and dynamic methods.

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