BLAST WAVE MEASUREMENT TECHNIQUES: STRUCTURAL RESPONSE AND CALIBRATION

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This paper will summarize the instrumentation and methods for measuring the response of structures to air blast which have evolved over the past fifty years. These systems and devices are discussed in the MABS Monograph, Vol. III, Measurement Techniques and Instrumentation: Air Blast Structural Target and Gage Calibration 1943-1993.
Target loading and response data sought from structures exposed to air blast was found through experience to come very slowly. Measurements at first included the basic parameters of blast pressures, acceleration, displacement, strain, and time of collapse. Expansion was soon made to cover earth pressure, earth strain, angular velocity and soil particle velocity. Measurement devices took the form of both passive and active systems similar in principle to the systems used for free field air blast measurements. Self-recording time devices were created and deployed as primary and secondary measurement systems.

Sensor systems in the nuclear days were confronted with the deleterious effects of the detonation itself and so systems found to be successful in freefield testing were adapted for structural measurements. One of these systems was the E-Coil design of the Wiancko pressure gage. This principle was used successfully in the design of an accelerometer and an earth pressure gage.

Large displacements expected of structural members were measured by an innovative design by The Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland, where a piano wire was held in place between the point of measurement and a rigid surface by a helical wound spring. An electrical circuit using a potentiometer was used to record the movement. A device to measure the maximum displacement of the walls of a structure or of a ceiling slab was a French designed concrete deformeter. A steel rod was erected vertically, horizontally, or at 45 degrees between walls or floor and ceiling, and it contained a steel punch screwed into one end which penetrated a lead disk in response to the blast forces.
A similar system was the mechanical deflection - time gage which was designed by The Defense Research Establishment-Suffield. Alberta, Canada, to measure the radial motion of the sandwich hemispheres of a radome relative to a bridge in the center. A light aluminum arm hinged at both ends was attached to the inner shell surface at each location. Radial motion of the arm was recorded by a pen trace on a moving paper tape.
These systems will be described in detail in the paper along with other systems that were used to obtain structural response parameters. Devices for calibrating pressure gages will also be discussed.