NASA TECH BRIEF

Lyndon B. Johnson Space Center

Dynamic Testing of Complex Structures

The problem:

Because it cannot be made by theoretical techniques, the prediction of the dynamic behavior of complex structures, such as automobiles or aircraft, requires special testing methods.

The solution:

The response of the structure is determined under impulses large enough to create severe strains. An electrodynamic shaker delivers an impulse load as large as 158 x 10^3 newtons (35,000 pounds force) for a duration as short as 0.8 millisecond. The shaker can provide impulses to nearly any point on the structure and can deliver repeated pulses of varying force and duration with practically no change in the test arrangement.

How it's done:

An electrodynamic shaker is used to deliver the impulse. The shaker has a striker which delivers the impulse by impacting a striker-plate that is placed on the structure to be tested. The striker and striker-plate are both made from cemented tungsten because this impact resistant material has the high modulus of elasticity necessary to achieve a short pulse duration.

Connected between the striker and the shaker is a force transducer consisting of a quartz load link of 158 x 10^3 newtons capacity held between a base and impact cap.

The motion of the shaker is controlled by an exact waveform synthesizer. The shape of the synthesizer output is shown in Figure 1. The shaker is programmed to deliver the impulse at the point of maximum shaker velocity as shown in Figure 2. Because the gap between the striker and the striker-plate is held constant, the pulse amplitudes are varied by changing the duration of the velocity pulse. This adjusts the velocity of the shaker upon impact. An impulse of long duration may be delivered by shaping the velocity of the shaker, as shown in Figure 3, with the striker and striker-plate in contact.

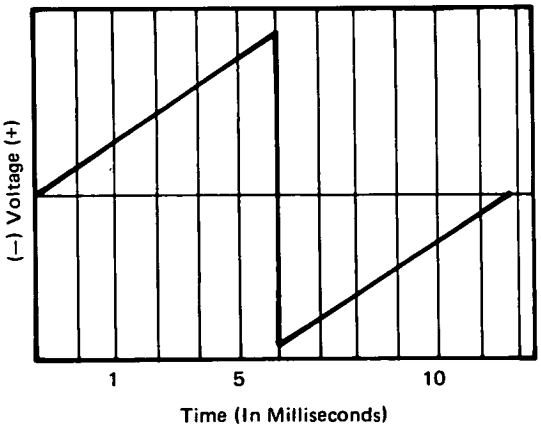

Figure 1

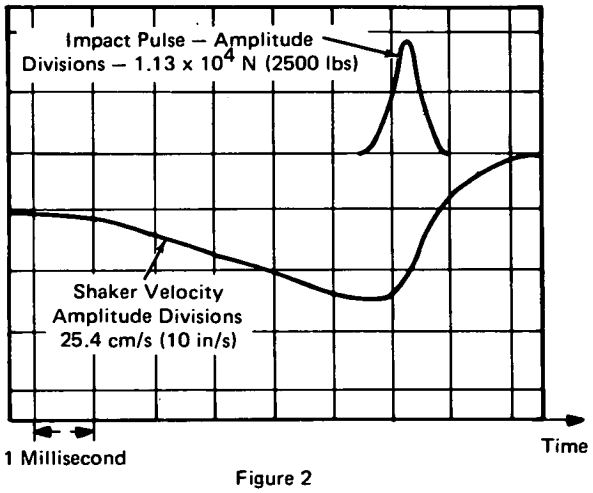

Figure 2

Strain gauges placed on the structure are used to measure the effects of the impact. During a typical test, approximately forty specimen-responses are recorded for post-test analysis on a multiplex analog computer.

(continued overleaf)

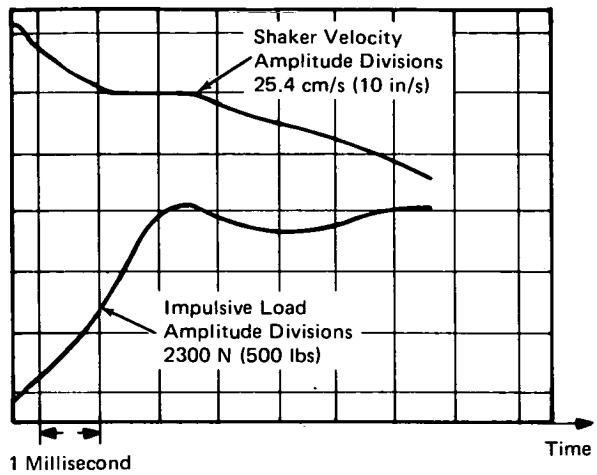

Figure 3

Note:

Requests for further information may be directed to:
Technology Utilization Officer
Lyndon B. Johnson Space Center
Code JM7
Houston, Texas 77058
Reference: TSP73-10057

Patent status:

NASA has decided not to apply for a patent.

Source: Charles Birs and Peter Anderson of
Grumman Aerospace Corp.
under contract to
Johnson Space Center
(MSC-12569)