RADIATION FROM AN EXPLOSION IN A NON-UNIFORMLY PRE-STRESSED MEDIUM

by

Anil Grover, B.Sc. (Hons.), M.Sc., A.I.S.M.

A Digest Presented to the Faculty of the Graduate School of Saint Louis University in Partial Fulfillment of the Requirements for the Degree of Master of Science(Research)

1971

DIGEST

The purpose of this study is to investigate the problem of the elastic wave radiation from an explosion in a non-uniformly pre-stressed medium. It is known that both an increase of the cavity size and rupture propagation resulting from an explosion in such a medium will release strain energy stored in the initially strained material, thus affecting the seismic radiation field. From their model experiments Kim and Kisslinger have concluded that the disturbance created by an explosion propagating outward as an elastic wave will be affected by the redistribution of strain in the medium. The modified strain field results in the formation of cracks or rupture in a preferred direction and in a non-symmetric radiation pattern. In this study an attempt has been made to understand the creation of cracks in a preferred direction in terms of the distribution of non-uniform stresses in the medium.

A rhomboid-shaped Plexiglas plate was used for the series of experiments. Under uniaxial tension, a distribution of shear stresses was produced in the plate. The static stress analysis of

the plate was done by the photoelastic and analytic methods. A cylindrical explosive charge was used as a source to generate seismic waves. The detection system for picking up the seismic waves was comprised of capacitor receivers. The shot and the detectors were positioned according to the distribution of stresses in the medium.

The termination of crack propagation produced a detectable secondary seismic arrival, corresponding to the stopping phase. The directions of the cracks corresponded to the theoretically computed average orientation of the maximum shear stress and close to the normal to the applied tension. The velocity of the crack propagation was determined as 0.833 km/sec., 0.6 times the shear wave velocity in the Plexiglas. With the introduction of prestresses in the medium, the radiation pattern of P-wave was altered from the cylindrical symmetry. The effect of the stored strain energy release on the amplitudes was so prominent that the theoretical radiation pattern of the crack model given by Knopoff and Gilbert could not explain the observed data.

Further, shear waves were generated in the presence of prestresses. An increase of S-wave amplitudes at all azimuths might be suggested as the criterion for determining the effect of stored strain energy release and of radial cracking.

Distribution of ambient stresses in the medium produced an observable effect on the frequency spectrum of an explosion. The addition of troughs in the spectrum at higher frequencies was severe along the azimuths of higher stresses around the source.