INTRODUCTION

The information that I will present in this publication will describe for the most part results obtained from research projects conducted in the Photomechanics Laboratory at the University of Maryland over the past twelve years. The work has been accomplished by the author in conjunction with Drs. J.W. Dally, D.B. Barker, D.C. Holloway and Mr. Anders Ladegaard-Pedersen (Swedish Detonics Research Foundation). The research work was dynamic in nature and involved the application of dynamic photoelasticity, dynamic holography, or high speed photography.

The particular topics to be discussed involve fracture control blasting, fragmentation, well stimulation, and vibrational analysis. This first chapter describes model testing and field testing conducted to improve smooth wall blasting techniques. Other topics will follow in subsequent chapters.
Excavation in hard rock is usually accomplished with a drill and blast procedure where a hole is drilled in the rock, packed with high explosives, stemmed and the explosive detonated. The detonation pressures are extremely high and an extensive amount of energy is dissipated at the borehole by crushing the adjacent rock and in producing a dense radial crack pattern about the hole. These radial cracks arrest quickly and only about 8 to 12 randomly oriented cracks extend for any significant distance from the borehole.

Since this process dissipates much of the energy in crushing the rock at the borehole and the resulting crack pattern is randomly oriented, very little control of the fracture plane is achieved. Where control of the fracture process is important, the conventional drill and blast procedure is modified. Pre-splitting, post-splitting, and smooth blasting procedures have been developed which, to some degree, control the fracture process.

In pre-splitting, a row of closely spaced and highly charged holes are detonated simultaneously. The resulting stress waves interact to produce cracking in the region between the holes where the stress waves overlap and double the dynamic stresses. These highly charged holes, of course, produce extensive cracking at the borehole and weaken the wall of an excavation. Also, simultaneous detonation results in excessively high ground shocks when excavations are made in populated urban areas. Post-splitting is almost identical except that the holes are fired after the central core of the excavation has been fragmented.

In smooth blasting, the holes are drilled on very close centers and cushioned charges are used. As control is obtained by spacing the holes, delays can be used and the ground shock reduced. Smooth blasting gives satisfactory results when enough holes are drilled and when the charge is properly cushioned; however, the number of holes which must be drilled and loaded increases the cost of the excavation.

EFFECTS OF NOTCHES IN A BOREHOLE

In early work conducted with Dally and Ladegaard-Pedersen [1] using dynamic photoelasticity it soon became obvious that to truly achieve