AIR BLAST PROPAGATION IN TUNNEL ENTRANCE CONFIGURATIONS: A SIMPLE METHOD TO PREDICT THE BLAST PARAMETERS FOR DIFFERENT CONFIGURATIONS OF PRACTICAL INTEREST

SCHLAEPFER,D.B.; BINGGELI,E.

Recent developments in conventional weapons technology have drastically increased the Potential threat of non-nuclear weapons to protective structures. Hence, the NC Laboratory Spiez of the Swiss Defense Technology and Procurement Agency has launched a program to study the blast wave propagation in tunnel entrance configurations caused by HE-detonations inside and near the tunnel entrance.

This research program is based on small scale blast simulation tests as well as numerical analyses with a large number of variations in geometry and yield. The overall objective is to develop a simple method to predict peak overpressure and impulse for many different configurations of practical interest. This method is based on dimensional analysis and the so-called "concept of charge equivalence". The "concept of charge equivalence" postulates that many geometrical deviations from the reference configuration - which is defined as the case of HE-charge detonating in the entrance of a straight tunnel - can be simulated by means of the results of the reference case, but using a reduced charge Q, instead of the effective charge Q. The ratio Xi= Qr/Q is a function of the change in geometry.

In the first part of the paper the reference configuration is analyzed in detail. Dimensionless representations of pressure and impulse are deduced by means of theoretical considerations, dimensional analysis, as well as experimental and numerical results. Special emphasis is placed on the behavior of static impulse. because in the past contradictory observations have lead to controversial discussions. For this purpose the time integrated momentum equation is discussed in detail. All terms of the equation are determined numerically and compared with experimental results.

In the second part of the paper the principal ideas of representing results of configurations deviating from the reference case are explained. An example of blast waves propagating in straight tunnels, considering detonation points inside the tunnel and outside its entrance, are given. The strengths and limitations of the "concept of charge equivalence" are demonstrated.