# VOLUMETRIC INVESTIGATION OF FALLBACK AND EJECTA PHENOMENA BY SHALLOW BURIAL SUBSURFACE HE DETONATIONS

M. A. Schenker, K. Safe & Y. Peretz

*Combat Engineering Corps – Fortifications & Current Security Branch, IDF, Israel*

Craters and crater formation is often used in the field of fortifications, especially for the immediate and hasty protection of personnel. A reliable model for estimating the amount of loose earth, in the crater and crater surrounding, can permit us to estimate the relevant time duration for removing the rubble and producing trenches.

In this paper a model will be developed for estimating the amount of earth ejected out of the crater formed when a detonation occurs and is piled up in various surrounding areas. This study will focus on the following areas:

1) The immediate area on the edge of the crater, in its entire scope (defined as Ejecta),
2) The area trapped between the Apparent-Crater and the True-Crater (defined as Fallback).

The model is based on various field experiments at sites with different soil characteristics such as loess, clay and sandy loess. The experiments were performed in shallow depths and with TNT charges up to 7.5 kg. The influence of tamping of the charge was also evaluated.

A Crater is defined as a cavity produced in a solid material, as a consequence of HE detonation. The prevention of gas pressure, the high temperature and the shock pressure produced causes large plastic strains and the formation of a cavity while some volume of solid material is thrown out (Crater Ejection). The ejected material can be divided into three parts, as follows:
**First part** is the amount of material which is ejected at high velocity out of the crater. **Second part** is the amount of material that is located on the edge of the crater around its scope (Ejecta**).**
**Third part** is the amount of material which falls back into the cavity formed by the explosion (Fallback) and forms the Apparent-Crater. This material can easily be evacuated and by this action, the True-Crater can in fact be revealed.

When evaluating the extent of the crater, four basic parameters are required: the quantity and type of explosive, the depth of the burial (DOB) and the type of the soil material in which the crater is formed.

During the crater formation process, different zones are formed in the soil: the failure zone, the plastic zone, and the upheaval zone. The failure zone is located in the immediate surroundings of the crater. The plastic zone is located around the failure zone, and the upheaval zone is on the edge of the crater and covered by the ejected earth. The research presented in this paper is focused on the plastic and upheaval zones.