

Guidance Document for Vibration Monitoring of Quarry Blasting

1. General Introduction

The following guidelines are being published so as to provide quarry operators with details as to how and what is required in order to monitor vibrations from blasting operations in quarries. This document provides threshold levels for vibration monitoring, together with other specifications related to location, design and sensitivity of the monitoring equipment.

The purpose of quarry blasting is to fracture or fragment rock mass so to enable excavation. Blasting at quarries can have adverse impacts that extend beyond the site boundary. Potential environmental impacts of quarry blasting include ground vibration (seismic waves), air overpressure, noise, dust and flyrock. Vibrations transmitted through the ground and pressure waves through the air are the most common side-effects of blasting operations.

Ground vibrations are an integral part of the process of rock blasting. The wave motion spreads concentrically from the blasting site, particularly along the ground surface, and is therefore attenuated, since its fixed energy is spread over a greater and greater mass of material as it moves away from its origin. Even though it attenuates with distance, the motion from a large blast can be received from far away. Air overpressure on the other hand, is energy transmitted from the blast site within the atmosphere in the form of pressure waves. As these waves pass a given position, the pressure of the air rises very rapidly then falls more slowly then returns to the ambient value after a number of oscillations. The maximum excess pressure in this wave is known as the peak air overpressure, generally measured in decibels linear (dB).

Malta has a number of quarry operators that are engaged in the extraction of resource particularly through blasting operations. The Malta Environment and Planning Authority (MEPA) is responsible for overseeing the implementation of regulations and legal obligations related to quarry operations. In this regard, the Authority will require the monitoring of vibration levels from blasting operations as per guidelines provided below.

2. General Conditions & Requirements

The guidelines and conditions set out in this guidance document:

- Apply to all quarry operators that extract resource through blasting activities;
- Apply to all quarry operators subject to the submission of a compiled and fully reviewed method statement by MEPA. The method statement will be required as part of the operational permit which is obligatory for all active quarries;
- Do not override the requirements of any other relevant legislation;
- Compliance with the method statement will be enforced as required by the competent authorities;

Operators have an obligation to fully understand and implement the requirements of these guidelines. In addition, operators should also take into consideration and fulfill the obligations of (i) the method statement (submitted to the Authority prior to the commencement of operations) and (ii) the submission of a vibration monitoring report, upon completion of each blasting

session. The Authority reserves the right to request revisions to the method statement at any point of the quarry operations.

The permit holder is obliged to contract suitably qualified and recognized monitoring service providers for vibration monitoring of blasting in quarries. The monitoring service provider, which is to be approved by the Authority, is obliged to adhere to all responsibilities stipulated in the TORs and submit all the documentation as requested by the Authority.

The choice of the blast design and technique is the sole responsibility of the operator. Whichever blasting technique is deployed, minimal environmental impact is to be envisaged. All blasting operations should be carried out by suitably qualified and competent persons.

3. Monitoring of Vibrations

3.1 Monitoring points

- 3.1.1 The choice of the location of the monitoring points, monitoring distance (from the blasting area) and equipment shall be in line with the guidelines provided in the British Standards *BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites. Vibration*, and *BS ISO 4866:2010 Mechanical vibration and shock-vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures*.
- 3.1.2 The choice of the location and number of the monitoring points should take into consideration the main sensitive receptors from the area where the mineral is being extracted. Sensitive receptors are those structural areas, buildings, historical monuments, buffer zones, residences, sites of geological, archaeological and ecological importance, and any other structures and sensitive land uses which could be affected by vibrations resulting from blasts in quarries.
- 3.1.3 The choice of the location and number of the monitoring points should correspond with the data submitted in the method statement.
- 3.1.4 No blast monitoring shall commence prior to the submission of a method statement to the Authority and subsequent approval by the respective Authorities.

3.2 Monitoring equipment

- 3.2.1 The measurement of vibration shall be undertaken using specific equipment designed for the monitoring of blast vibration. Such instrumentation shall comprise transducers, signal conditioning and data recording elements.
- 3.2.2 The overall monitoring equipment should have an adequate sensitivity and frequency range of vibration frequency and velocity magnitudes.
- 3.2.3 The instrumentation shall be capable of recording both ground and airborne vibration.
- 3.2.4 Details regarding the instrumentation used for the monitoring of blasting vibrations should correspond with the data submitted in the method statement.

3.3 Parameters to be monitored

3.3.1 The monitoring equipment shall take into account the following parameters:

- i. Peak particle velocity (PPV): This is a measure of ground vibration magnitude and is the maximum instantaneous particle velocity at a point during a given time interval in mm/s. PPV is normally recorded in 3 mutually perpendicular directions; transverse, vertical and longitudinal (T, V & L)
- ii. Frequency: A measure of the speed at which a particle vibrates, or how close the waves are to each other. Frequency is measured in terms of Hertz (Hz).
- iii. Air overpressure: A measure of the pressure waves transmitted through the atmosphere in terms of decibels (dB).

3.3.2 Measurements of each parameter shall be made according to the guidelines provided in BS 5228-2: 2009 and BS ISO 4866:2010.

3.4 Geological, topographic & meteorological information

3.4.1 Blast monitoring should also take into consideration the geological, topographic and meteorological conditions for the area (quarry) in question. Details regarding (i) distinctive geological and/or geo-morphological features, (ii) wind speed and direction (iii) temperature (iv) cloud cover (v) humidity levels and (vi) atmospheric pressure must be submitted in the method statement.

3.4.2 Monitoring shall preferably be carried out in non-windy conditions so as to limit the effect on air overpressure readings. Meteorological conditions shall be recorded during the blasting activity and appropriately accounted for in the blast monitoring report.

4. Acceptable levels

4.1 Measurements of each parameter shall be made according to the guidelines and limit values stipulated in BS ISO 4866:2010.

4.2 Ground vibration as a result of blasting operations shall not exceed a peak particle velocity of 4mm/s as measured at the nearest sensitive receptor within a 200m distance from the blasting area. The frequency at which the ground vibration is measured shall range between 20 to 40Hz.

4.3 Airblast overpressure levels from blasting shall not exceed 120dB (L peak).

5. Presentation of data

5.1 The data collected during the monitoring session shall be presented in a report, within 5 (five) days of the blasting operations, which shall include data tables and collection sheets, graphs (monitoring curves for both ground and air overpressure vibrations) and an executive summary.

- 5.2 The exact location and number of blast monitoring stations, date, time and duration for each quarry blast session should be included in the report which is to be submitted to the Authority.
- 5.3 The resultant vibration monitoring data should be compared to relevant (vibration) limit values stipulated in BS ISO 4866:2010.