DEDICATED TO MY BELOVED PARENTS

FOR THEIR LOVE, SUPPORT AND ENCOURAGEMENT

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It is certified that the work contained in the thesis titled **"Evaluation of Blast Induced Ground Vibration and Powder Factor in Surface Limestone Quarries Using Statistical and ANN Approach** "by ***"PUNIT PAURUSH"*** has been carried out under our supervision and this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Comprehensive Examination, Candidacy and SOTA for the award of Ph.D. Degree.

Prof. Piyush Rai
(Supervisor)
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005, INDIA

Dr. Suresh Kumar Sharma
(Co-supervisor)
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005, INDIA

DECLARATION BY THE CANDIDATE

I, ***"PUNIT PAURUSH"***, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of ***"PROF. PIYUSH RAI"*** and co-supervision of ***"DR. SURESH KUMAR SHARMA"*** from ***"JULY 2015" TO "JULY 2021"***, at the ***"DEPARTMENT OF MINING ENGINEERING"***, Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that, I have not willfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, theses, *etc*., or available at websites and have not included them in this thesis and have not cited as my own work.

Date:

Place: Varanasi ***Punit Paurush***

CERTIFICATE BY THE SUPERVISOR

It is certified that the above statement made by the student is correct to the best of my knowledge.

Prof. Piyush Rai
(Supervisor)
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005, INDIA

Dr. Suresh Kumar Sharma
(Co-supervisor)
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005, INDIA

Prof. Piyush Rai
(Head of Department)
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005, INDIA

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(PUNIT PAURUSH)

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ABSTRACT

Blasting is one of the most economical methods used for fragmenting rock mass. However, rock blasting causes a number of nuisances, such as ground vibration, air overpressure, fly rock, dust etc. It is consequential to state that merely 20-30 % of the explosive energy is used to fragment and displace the rock mass, while the rest is dissipated in the form of ground vibration, air blast, noise, and fly-rocks, etc. Further the impact of efficacy is also assessed by evaluation of powder factor. The powder factor impacts secondary breakage and the diggability of the excavators. The thrust area of the research has been to identify the blasting design and explosive parameters affecting peak particle velocity and powder factor for controlling the blasting nuisances. Many studies have been conducted earlier using only a limited number of controllable blast design parameters affecting peak particle velocity and powder Factor. However, only a limited number of studies have been carried out including a host of significant controllable blast design parameters.

In light of this, the present work contributes by developing a model using principal component analysis and step-wise selection and elimination statistical technique. The developed equation is validated within the statistical domain and the verified by employing multi-layer perceptron (artificial neural network) technique.

To comply with the objectives of research work, the sites for experimental blasts were selected considering almost similar geo-mining conditions. A total of 285 number of blasts (from three quarries) were recorded. Accordingly, the complete dataset comprising of 97 blast round in quarry ‘A’, 88 blast round in quarry ‘B’ and 100 blast round in quarry ‘C’ were produced for analysis. All the datasets recorded in terms of blasting design parameters and subsequently, the value of peak particle velocity is recorded and the value of powder factor were measured. In all the quarries, the 75% of datasets were used for development of the model and 25% were used for the validation of the developed model. Further, to develop the statistical models in the form of equation for powder factor and peak

particle velocity, principal component analysis and stepwise selection and elimination followed by multi-variate linear regression technique have been used. The developed equations have been validated on another dataset and further verification has been carried out.

On validation within the statistical domain, for peak particle velocity and powder factor in all the quarries, the predicted values of peak particle velocity and powder factor are lying closer to the measured values. But, the values predicted by principal component analysis reveals the most accurate values of peak particle velocity and powder factor in comparison to stepwise selection and elimination and square root equation (in case of peak particle velocity only).

Apart from the statistical domain, Multilayer Perceptron (ANN) technique has also been used to verify the equation developed by both principal component analysis and stepwise selection and elimination tools and also to determine the correlation between the blasting design parameters with peak particle velocity and powder factor. It is found that the value of R^2 derived by artificial neural network is much higher than the values of R^2 derived by both principal component analysis and stepwise selection and elimination. This indicates that the accuracy of artificial neural network in predicting peak particle velocity and powder factor is very much satisfactory in comparison to principal component analysis and stepwise selection and elimination, and doubly validate the authenticity of equation developed by principal component analysis and stepwise selection and elimination in predicting the peak particle velocity and powder factor. However, principal component analysis and stepwise selection and elimination have also indicated excellent value of R^2 vis-à-vis better authenticity of the model to predict both peak particle velocity and powder factor.