



Blast Clearance Estimator Training Manual

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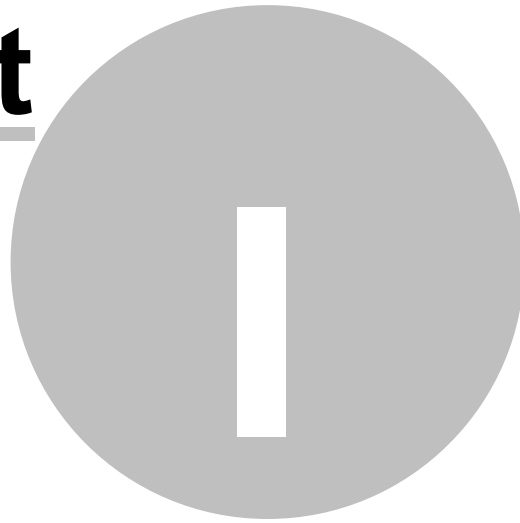
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1. Introduction

When blasting operations are carried out, the rock gets fragmented and the fragmented material is moved forward to make mucking of the fragmented mass easier and less costly. In addition to this desirable displacement of broken fragments in case of surface mine blasting or excavation blasts some stone pieces can get torn and travel to very large distances. Usually this unexpected projection of stone is termed as 'Flyrock' (Fig. 1).

Flyrock is a serious environmental hazard and is often a cause of fatalities, serious injury to people, damage to equipment, buildings, property, etc.



Terrock has developed a flyrock model that simplifies what is dynamically complex problem in physics. The algorithm makes use of a limited number of significant factors it is practical to measure and control in the field.

The model is calibrated in actual field conditions, and further observations are made thereafter to confirm model performance. Based on this model, FlyRock Predictor software is developed.

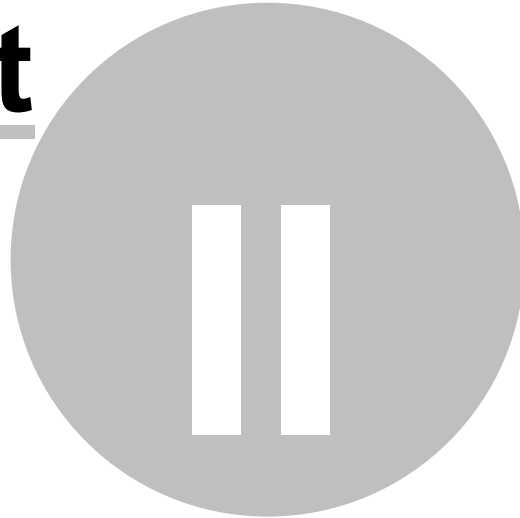
FlyRock Predictor software will allow user to 'design your own flyrock'. The quantification can be used to establish both safe clearance distances and the critical range of burdens and stemming heights. The zone of flyrock travel is indicated by this tool.

Inputs to the software are charge mass, burden or stemming height and a site constant that lays within a general range that can be fine-tuned by site calibration and the output is flyrock distance.

Top Level Intro

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Part



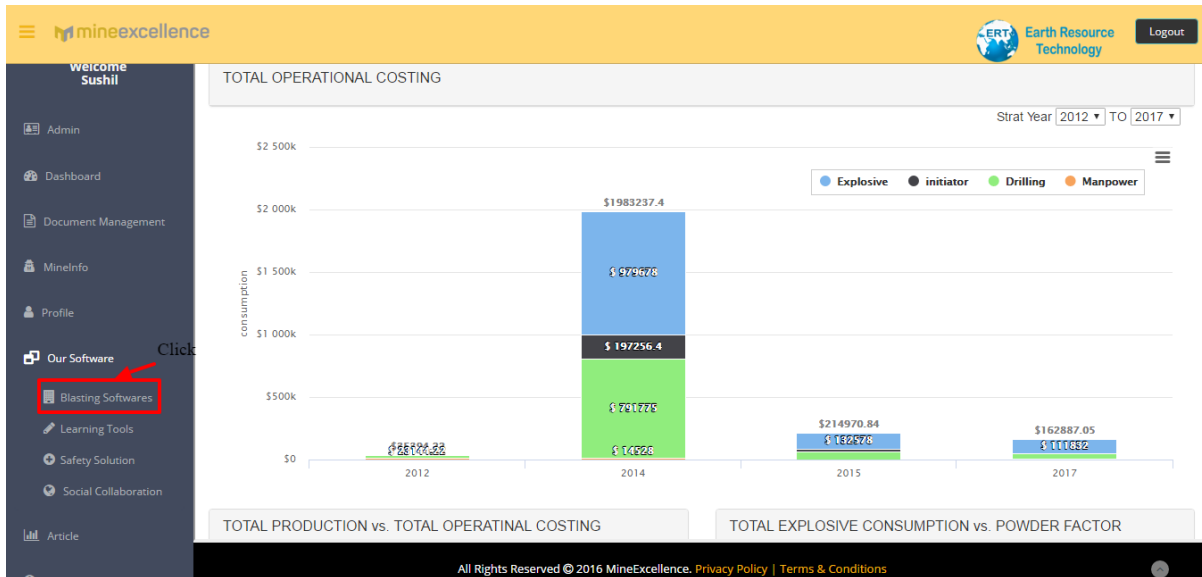
2. System Architecture

2.1 Starting the Application

You can start the FlyRock Prediction software by once logging in from the Mine Excellence Site.

2.2 Flyrock Architecture

Once you login from the MineExcellence site, a dashboard will be displayed as shown in fig. below



On Click of Blasting Software link available on the left side of the dashboard you will be redirected to the list of software available in the Mineexcellence as shown in fig. below.

The screenshot shows the MineExcellence dashboard. The top navigation bar includes the MineExcellence logo, 'Earth Resource Technology', and a 'Logout' button. The left sidebar contains a 'Welcome Sushil' message and a menu with options: Admin, Dashboard, MineInfo, Profile, Our Software (with sub-items: Blasting Softwares, Learning Tools, Safety Solution, Social Collaboration), and a footer with 'All Rights Reserved © 2016 MineExcellence. Privacy Policy | Terms & Conditions'.

The main content area is titled 'Blasting Softwares' and displays six software tiles:

- BIMS**: Blast Information Management System (BIMS)
- FRAGMENTATION PREDICTION**: Fragmentation Prediction
- PATTERN SIMULATION AND ANALYSIS**: Pattern Simulation and Analysis
- BLAST CLEARANCE ESTIMATOR**: Blast Clearance Estimator (highlighted with a red box)
- AIR BLAST PREDICTION**: Air Blast Prediction
- GROUND VIBRATION PREDICTION**: Ground Vibration Prediction
- BLADES**: Blast Designer (BLADES)

On click of Blast Clearance Estimator, you will be redirected to Blast Clearance Estimator Page as shown in fig. below.

The screenshot shows the Blast Clearance Estimator page. The top navigation bar includes 'Home', 'Mine Details', 'Logout', 'MINE NAME - ABC', and 'BLAST NAME - 123'. The main content area is titled 'Design Parameters' and contains a form with the following fields:

- Burden(m)
- Charge Mass(kg/m)
- Drill Hole Angle
- Drill Hole Diameter(mm)
- Stemming Height(m)
- Constant
- Plant Equipment safety factor
- Personal safety factor
- Throw in front of face(m)
- Throw behind face(m)

Below the form are four buttons: 'Set Default', 'Calculate Throw', 'Predict Flyrock', and 'Charge Mass Calculation'. A large light green area on the right contains the text: 'Please enter the Design Parameters and click on "Predict Flyrock" button'. The footer reads: 'Blasting Predictors & Control Tools 3.3.0 Developed by Continuous Excellence'.

2.2.1 Menu Bar

This is top most part of the screen. This bar displays menu items defining the basic functionality of the software. Following are menu items are present in the menu bar:



1. Home - Redirect user to the Home Page of the website
2. Mine Details - Here we can edit the Mine Name and the Blast location
3. Logout - User can logout by click of this button
4. Mine Name - Name of the mine
5. Blast Name - Name of the blast

2.2.2 Mine Details

This function allow user to save mine details which include Mine Name and Blast Location. This information has to be filled as it is needed for generating report. To save mine details, click on Edit Mine details. Once Mine Details are saved, we can close this pop up by clicking simply on Close button.

A light blue rectangular form with a white border. It contains two input fields: 'Mine name' with the value 'ABC' and 'Blast location' with the value '123'. Below the input fields are two black buttons with white text: 'Edit Mine Details' and 'Close'.

2.2.3 Design Parameters

Following parameters are required to predict the flyrock and to calculate throw of the blast. It includes:

- Burden
- Charge Mass
- Drill Hole Angle
- Drill Hole Diameter
- Stemming Height
- Constant
- Plant Equipment safety factor
- Personal safety factor

User can use the default parameters by clicking on Set Default button. It also allow user to edit these parameters as per their operational requirement.

The screenshot shows the 'Design Parameters' form in a web application. The form is located on the left side of the page and contains several input fields with pre-filled values. The right side of the page is a large light green area with a red text message: 'Please enter the Design Parameters and click on 'Predict Flyrock' button'. The top navigation bar includes 'Home', 'Mine Details', and 'Logout' on the left, and 'MINE NAME - ABC | BLAST NAME - 123' on the right. The bottom of the page has a footer: 'Blasting Predictors & Control Tools 3.3.0 Developed by Continuous Excellence'.

Design Parameters	
Burden(m)	4
Charge Mass(kg/m)	8.30
Drill Hole Angle	15
Drill Hole Diameter(mm)	115
Stemming Height(m)	2.5
Constant	27
Plant Equipment safety factor	2
Personal safety factor	4
Throw in front of face(m)	
Throw behind face(m)	

Buttons: Set Default, Calculate Throw, Predict Flyrock, Charge Mass Calculation

Message: Please enter the Design Parameters and click on 'Predict Flyrock' button

Footer: Blasting Predictors & Control Tools 3.3.0 Developed by Continuous Excellence

2.2.4 Calculate Throw

On clicking, Calculate Throw button which will give the user the value of Throw (front of face) and throw (behind of face) in meters by calculation with above parameters.

This screenshot is identical to the one above, showing the 'Design Parameters' form. The 'Calculate Throw' button is highlighted, indicating it has been clicked. The rest of the interface, including the navigation bar, footer, and the right-side message, remains the same.

Design Parameters	
Burden(m)	4
Charge Mass(kg/m)	8.30
Drill Hole Angle	15
Drill Hole Diameter(mm)	115
Stemming Height(m)	2.5
Constant	27
Plant Equipment safety factor	2
Personal safety factor	4
Throw in front of face(m)	
Throw behind face(m)	

Buttons: Set Default, Calculate Throw, Predict Flyrock, Charge Mass Calculation

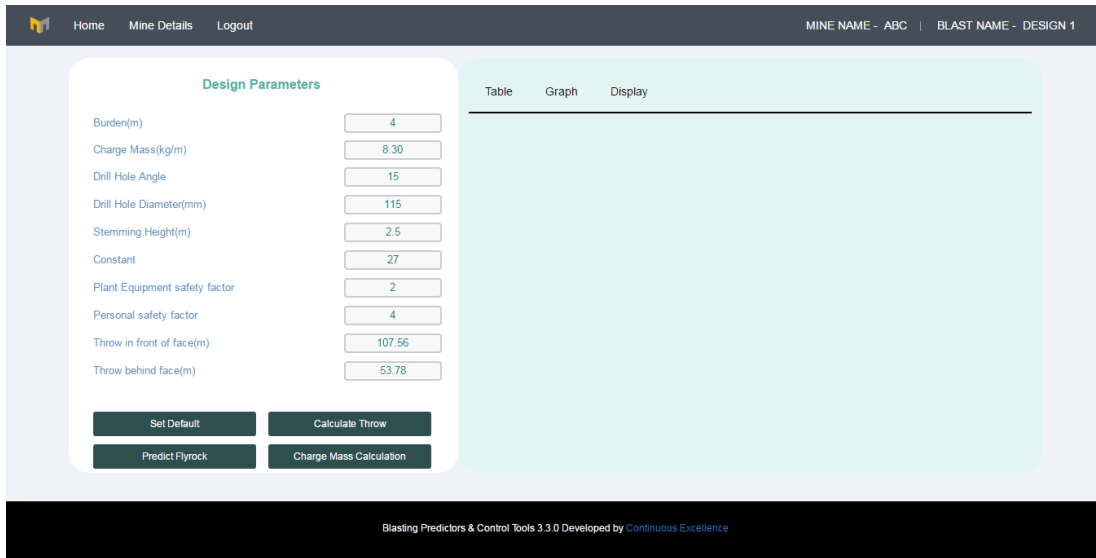
Message: Please enter the Design Parameters and click on 'Predict Flyrock' button

Footer: Blasting Predictors & Control Tools 3.3.0 Developed by Continuous Excellence

2.2.5 Predict Flyrock

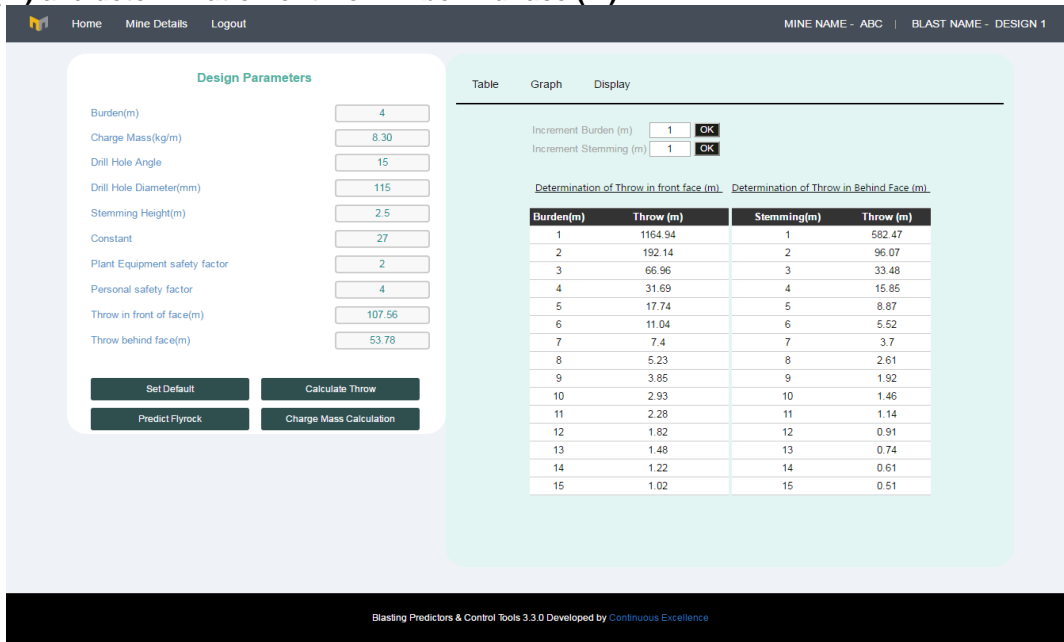
When a user clicks on Predict FlyRock button, page containing following tabs is displayed, as shown:

- Table
- Graph
- Display



2.2.5.1 Table

This will give the prediction results, Throw (Front and Behind of face) in tabular format. By default the increment in burden and stemming is of 1. As per this burden and stemming value the throw is calculated and values are formulated in the below tables, separately for throw in **determination of throw in front face (m)** and **determination of throw in behind face (m)**.



The user can change the value of increment burden and stemming as per their requirement and click on Ok button. It will automatically change the difference between the burden and stemming values in the table and calculate throw of front face and behind face both.

The screenshot shows the 'Design Parameters' section on the left with various input fields and buttons. On the right, the 'Table' tab is active, displaying a table with columns for Burden(m), Throw (m), Stemming(m), and Throw (m). The table contains 15 rows of data. Below the table, there are two sub-sections: 'Determination of Throw in front face (m)' and 'Determination of Throw in Behind Face (m)'. The interface also includes a navigation bar at the top with 'Home', 'Mine Details', and 'Logout' options, and a footer with the text 'Blasting Predictors & Control Tools 3.3.0 Developed by Continuous Excellence'.

Burden(m)	Throw (m)	Stemming(m)	Throw (m)
1	1164.94	1	582.47
3	66.96	3	33.48
5	17.74	5	8.87
7	7.4	7	3.7
9	3.85	9	1.92
11	2.28	11	1.14
13	1.48	13	0.74
15	1.02	15	0.51

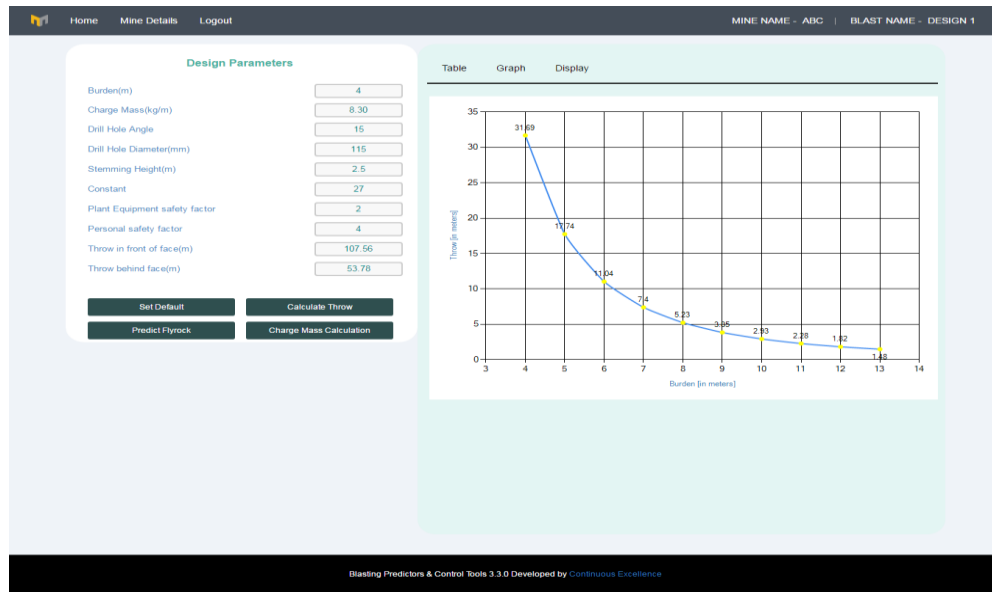
2.2.5.2 Graphs

The results will be displayed in the graph format in which x-axis defines the burden value (in meters) and y axis will shows the throw value (in meters).

When user will click on Graph tab (burden and throw value) is displayed on the graph.

This screenshot shows the same software interface as above, but with the 'Graph' tab selected. The graph displays a blue curve representing the relationship between Burden (in meters) on the x-axis and Throw (in meters) on the y-axis. The x-axis ranges from 3 to 14, and the y-axis ranges from 0 to 35. The curve starts at approximately (4, 32) and decreases as the burden increases, following the data points in the table. The interface elements, including the 'Design Parameters' section and the footer, remain the same.

When user will click on check box” Show Points” on Graph tab (burden and throw value) is displayed on the graph with the points.



2.2.5.2 Display

When user clicks on Display tab, user is redirected to the page as shown, this page contains the following:

- Search Blast Location
- Flyrock Angle
- Radius

Along with that the outcome is displayed in this graphical design which specifies 3 regions in meters for behind and front of face.

- Maximum throw
- Plant clearance
- Personnel clearance

Home Mine Details Logout MINE NAME - ABC | BLAST NAME - DESIGN 1

Design Parameters

Burden(m)

Charge Mass(kg/m)

Drill Hole Angle

Drill Hole Diameter(mm)

Stemming Height(m)

Constant

Plant Equipment safety factor

Personal safety factor

Throw in front of face(m)

Throw behind face(m)

Table Graph Display

Search Blast Location Flyrock Angle

Radius

Maximum Throw DGMS(500m) Plant Clearance Personal Clearance

Map Satellite

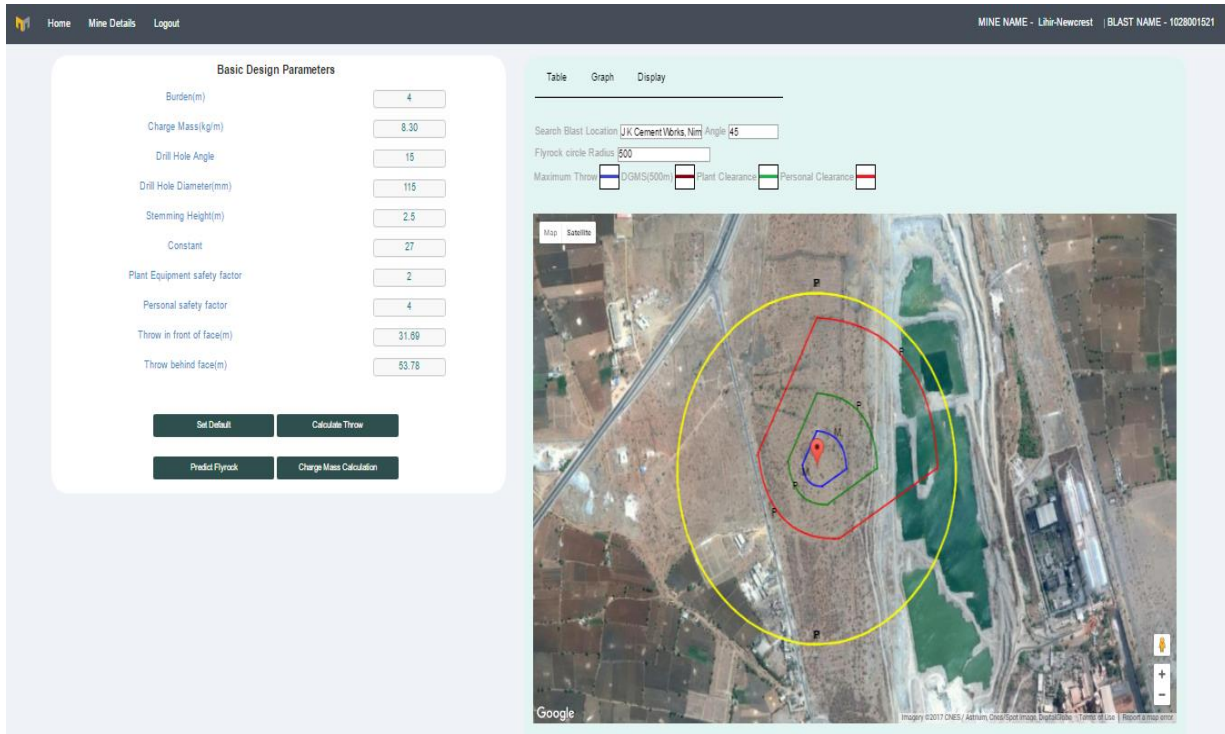
Google

Blasting Predictors & Control Tools 3.3.0 Developed by Continuous Excellence

To predict flyrock, user enters the data in following fields:

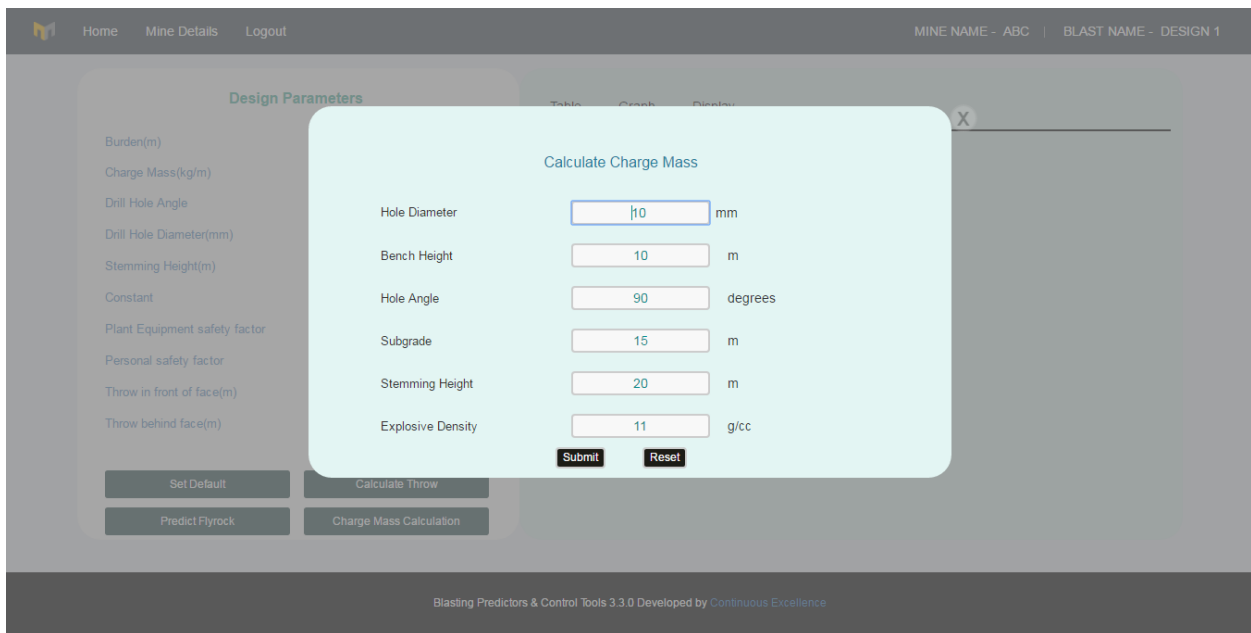
- Search Blast Location
- Flyrock Angle
- Radius

After entering the required data when user clicks on the map, predicted flyrock area is displayed.



Charge Mass Calculation:

This function allow user to calculate the charge mass. When user click on Charge Mass Calculation option, it will ask user whether to calculate charge mass.



For calculating Charge Mass following parameters are required:

- Hole Diameter
- Bench Height
- Hole Angle
- Subgrade
- Stemming Height
- Explosive Density

The screenshot displays a web application interface for calculating Charge Mass. The main window is titled "Design Parameters" and contains a list of parameters on the left side, including Burden(m), Charge Mass(kg/m), Drill Hole Angle, Drill Hole Diameter(mm), Stemming Height(m), Constant, Plant Equipment safety factor, Personal safety factor, Throw in front of face(m), and Throw behind face(m). Below this list are buttons for "Set Default", "Predict Flyrock", and "Charge Mass Calculation".

A modal dialog box titled "Calculate Charge Mass" is open in the center. It contains the following input fields and values:

Parameter	Value	Unit
Hole Diameter	10	mm
Bench Height	10	m
Hole Angle	90	degrees
Subgrade	15	m
Stemming Height	20	m
Explosive Density	11	g/cc

Below the input fields are "Submit" and "Reset" buttons. The result "Calculated ChargeMass is=0.86" is displayed at the bottom of the dialog box.

The footer of the application reads: "Blasting Predictors & Control Tools 3.3.0 Developed by Continuous Excellence".

To calculate the Charge Mass for these parametric values, click on Calculate button and the result will be displayed below and close button will close the window.