SYSTEMS FOR AUTOMATED BLAST DESIGN PLANNING AND METHODS RELATED THERETO

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 62/801,312, entitled “SYSTEMS FOR AUTOMATED BLAST DESIGN PLANNING AND METHODS RELATED THERETO,” filed February 5, 2019, the contents of which are hereby incorporated herein by reference in their entirety.

Technical Field

[0002] The present disclosure relates generally to explosives. More specifically, the present disclosure relates to methods, systems and apparatuses for designing a blast plan.

Summary

[0002a] An aspect of the present disclosure provides a computer-implemented method for generating a blast plan, the method comprising:

receiving blast data comprising geometric and geological properties of a bench of a blast site to be blasted and a diameter and explosive properties of an available explosive product, wherein the geometric properties of the bench include a face height of the bench;

determining a pattern footage representing an area capable of being properly fragmented by the available explosive product in a blasthole located in the bench, wherein determining the pattern footage comprises determining a relationship between the face height, the specific energy of the available explosive product, and the geological properties of the bench;

determining a burden and a spacing from the pattern footage; and

generating a blast plan using the burden and the spacing.

[0002b] Another aspect of the present disclosure provides a system for generating a blast plan, the system comprising:

a memory device to store blast data comprising blast site dimensions, blast site geology, and available explosive types;

a processing unit to:

receive blast data comprising geometric and geological properties of a bench of a blast site to be blasted and a diameter and explosive properties of an available explosive product, wherein the geometric properties of the bench include a face height of the bench;

determine a pattern footage representing an area capable of being properly fragmented by the available explosive product in a blasthole located in the bench, wherein determining the pattern footage comprises determining a relationship between the face height, the specific energy of the available explosive product, and the geological properties of the bench;

determine a burden and a spacing from the pattern footage; and

generate a blast plan using the burden and the spacing.

Brief Description of the Drawings

[0003] The embodiments disclosed herein will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. The drawings depict primarily generalized embodiments, which embodiments will be described with additional specificity and detail in connection with the drawings in which:

[0004] FIG. 1 illustrates a network diagram of a blast plan modeling system according to one embodiment.

[0005] FIG. 2 illustrates a personal electronic device displaying a scanning path of a drone according to one embodiment.

[0006] FIG. 3 illustrates a block diagram of a blast design system according to one embodiment.

[0007] FIG. 4 illustrates a flow chart of a method for generating a blast design according to one embodiment.

[0008] FIG. 5 illustrates a flow chart of a method for generating a blast design by executing multiple simulations for a plurality of possible permutations according to one embodiment.

[0009] FIG. 6 illustrates an example of a method of generating a dataset of a plurality of permutations from blast data according to one embodiment.

[0010] FIG. 7 illustrates an example of a method for simulating the permutations of the dataset according to one embodiment.

[0011] FIG. 8A illustrates a first part of a method for generating blast level details according to one embodiment.

[0012] FIG. 8B illustrates a second part of a method for generating blast level details according to one embodiment.

[0013] FIG. 9 illustrates a method for finding a prioritized distance that fits on the blast site according to one embodiment.

[0014] FIG. 10 illustrates a method for generating hole level details for a given burden and space according to one embodiment.

Claims

1. A computer-implemented method for generating a blast plan, the method comprising:

receiving blast data comprising geometric and geological properties of a bench of a blast site to be blasted and a diameter and explosive properties of an available explosive product, wherein the geometric properties of the bench include a face height of the bench;

determining a pattern footage representing an area capable of being properly fragmented by the available explosive product in a blasthole located in the bench, wherein determining the pattern footage comprises determining a relationship between the face height, the specific energy of the available explosive product, and the geological properties of the bench;

determining a burden and a spacing from the pattern footage; and

generating a blast plan using the burden and the spacing.

2. The method of claim 1, wherein determining the pattern footage comprises calculating a geometric relationship of the face height to a diameter of the available explosive product, specific to the geological properties of the bench, to determine a raw pattern footage.

3. The method of claim 1, wherein determining the pattern footage comprises inputting a ratio of the face height to the diameter of the available explosive product as a variable into an equation with geological constants empirically fit to prior blast data from previous blasts that resulted in proper fragmentation of the particular bench material of the previous blasts to determine a raw pattern footage.

4. The method of claim 3, wherein the prior blast data includes actual explosive loaded data from site equipment used to load explosives in boreholes in the previous blasts.

5. The method of any one of claims 3-4, wherein determining the pattern footage further comprises modulating the raw pattern footage based on differences between the specific energy of the available explosive product and the explosive product used in the previous blasts from which the prior blast data was used in generating the equation.

6. The method of any one of claims 2-5, wherein determining the pattern footage further comprises modulating the raw pattern footage based on the volume of the available explosive product.

7. The method of claim 1, wherein determining the pattern footage comprises defining an area around holes in a blast plan, wherein the pattern footage comprises a product of a first factor based on the geological properties and the face height, a second factor based on the specific energy of the available explosive product, and a third factor based on a diameter of the available explosive product.

8. The method of claim 7, further comprising calculating the first factor by:

calculating a result of multiplying a first geological factor by the natural log of a dividend of a face height divided by the diameter of the available product; and

reducing the result by a second geological factor.

9. The method of any one of claims 7-8, further comprising calculating the third factor by dividing the diameter by a measuring unit factor, and squaring a resulting dividend.

10. The method of any one of claims 7-9, wherein determining the burden further comprises multiplying the square root of the pattern footage by a constant derived from a rock class from the geological properties of a blast site.

11. The method of any one of claims 1-10, wherein the geological properties of a blast site comprise rock density, rock type, rock strength, attenuation characteristics or combinations thereof; and

the method further comprising receiving blasthole parameters comprising the face height, desired blast pattern type, likelihood and/or potential amount of water in any blastholes drilled, and a diameter of an available drill; and

receiving information on the available explosive product comprising the type of the available explosive product, the weight and/or volume of the available explosive product as deliverable to the blast site, weight of material to be blasted, volume of material to be blasted, and number of holes that can be filled by the available explosive product as deliverable to the blast site.

12. The method of any one of claims 1-11 wherein the blasthole parameters comprise a desired blast pattern type, and wherein the constant is further derived based on a shape of the desired blast pattern type.

13. The method of any one of claims 1-12, wherein the blast plan comprises the burden and the spacing.

14. The method of any one of claims 1-13, further comprising generating a dataset comprising a plurality of permutations of the received blast data; and

simulating a blast for each of the plurality of permutations to determine a plurality of simulated results,

wherein the blast plan is based on a top scoring simulated result.

15. A system for generating a blast plan, the system comprising:

a memory device to store blast data comprising blast site dimensions, blast site geology, and available explosive types;

a processing unit to:

receive blast data comprising geometric and geological properties of a bench of a blast site to be blasted and a diameter and explosive properties of an available explosive product, wherein the geometric properties of the bench include a face height of the bench;

determine a pattern footage representing an area capable of being properly fragmented by the available explosive product in a blasthole located in the bench,

wherein determining the pattern footage comprises determining a relationship between the face height, the specific energy of the available explosive product, and the geological properties of the bench;

determine a burden and a spacing from the pattern footage; and

generate a blast plan using the burden and the spacing.