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ADMINISTRATIVE INFORMATION:

! This Engineering Bulletin (EB) is effective beginning with projects submitted for the letting of September 8, 2005.

! Superseded issuance(s): This EB does not supersede any previous issuances.

PURPOSE: The purpose of this EB is to issue the Geotechnical Engineering Manual (GEM-22) Procedures for Blasting.

TECHNICAL INFORMATION:

! The Geotechnical Engineering Manual (GEM-22) Procedures for Blasting specifies the procedure that shall be followed when a Contractor is proposing to blast. By following this procedure, the Engineer-In-Charge or the Permit Engineer can help ensure that the Contractor accomplishes the work in a safe and effective manner. Prior to blasting, the Contractor shall submit a written blast plan to the Engineer for conditional approval. The Engineer will forward the blast plan to the Geotechnical Engineering Bureau, Engineering Geology Section, for review and written comment. After approval, a preblast meeting will be held to discuss the proposed blasting operations. Final approval will be granted based upon the results of the meeting.

Engineering Geologists from the Geotechnical Engineering Bureau are trained and experienced in blasting safety and blasting techniques, and are available to provide assistance during all phases of the blasting operations.

! The Construction Division is currently working on revisions to Section 100 – Phase 5. The revised Section will include identification of the manual ‘Procedures for Blasting’ in the final version of §107-05 Safety and Health Requirements, Section N. Drilling and Blasting.

TRANSMITTED MATERIALS:

Attached are the procedures for blasting.

BACKGROUND: Presplit blasting is required on the State right-of-way when the design rock slope is one vertical on one horizontal, or steeper, and the vertical height of the exposed rock slope exceeds 1.5 m (5 ft.). The contract documents may also specify blasting. The Contractor may choose to use production blasting in conjunction with required presplit blasting or for general rock excavation. The Contractor may also elect to use blasting for trenching operations, structure excavations, and structure demolitions. Permit jobs that involve blasting within the State right-of-way are subject to the same requirements as Department-let contracts. If the Permit Engineer is concerned or uncertain about the effects of blasting adjacent to the right-of-way, the Engineering Geology Section should be contacted for advice.

CONTACT: Questions or comments regarding this issuance should be directed to Randy Romer of the Geotechnical Engineering Bureau at (518) 457-4714, romer@dot.state.ny.us. Questions or comments regarding the technical aspects of the procedure manual should be directed to Matt Balmer of the Geotechnical Engineering Bureau at (518) 457-4726, mbalmer@dot.state.ny.us.

PROCEDURES FOR BLASTING

GEOTECHNICAL ENGINEERING MANUAL

GEM-22

GEOTECHNICAL ENGINEERING BUREAU

January 2005



STATE OF NEW YORK DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL ENGINEERING MANUAL:
PROCEDURES FOR BLASTING

GEM-22

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING BUREAU

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I. INTRODUCTION

A. Purpose

This document specifies the procedure that shall be followed when a Contractor or Permittee is proposing to blast. By following this procedure, the Engineer-In-Charge or the Permit Engineer can help ensure that the Contractor accomplishes the work in a safe and effective manner. Engineering Geologists from the Geotechnical Engineering Bureau are trained and experienced in blasting safety and blasting techniques, and are available to provide assistance during all phases of the blasting operations. Prior to blasting the Contractor shall submit a written blast plan to the Engineer for conditional approval. The Engineer will forward the blast plan to the Engineering Geology Section, Geotechnical Engineering Bureau for review and written comment. After approval of the blast plan, a preblast meeting will be held which shall be attended by the Engineer, the Contractor, the Project Blaster(s), an Engineering Geologist from the Geotechnical Engineering Bureau, and representatives of all interested Agencies to discuss the proposed blasting operations. Final approval will be granted based upon the results of the meeting. Test blasts may be required and may result in modifications to the blast plan. All blasts on Department-let contracts will be documented by the Engineer using the Blasting Report Form GE 469 MET (2/00).

B. General

Presplit blasting is required on NYSDOT ROW when the design rock slope is one vertical on one horizontal or steeper and the vertical height of the exposed rock slope exceeds 1.5 m (5 ft.). The contract documents may also specify blasting. The Contractor may choose to use production blasting in conjunction with required presplit blasting or for general rock excavation. The Contractor may also elect to use blasting for trenching operations, structure excavations, and structure demolitions. Permit jobs that involve blasting on NYSDOT ROW are subject to the same requirements as Department-let contracts. If the Permit Engineer is concerned or uncertain about the effects of blasting adjacent to our ROW, the Engineering Geology Section should be contacted for advice.

The blaster will conduct all blasting operations in a skillful manner so as not to cause injury, damage property, adversely affect traffic, or cause the migration/accumulation of noxious gases. Blasting activities can have negative consequences which include the following:

1. Flyrock

Flyrock can cause serious injury or damage when it travels outside the blast zone. Several techniques can be used to control flyrock including the use of blasting mats or soil cover and by changing the drill hole layout or distribution of explosives.

2. Vibrations

Blasting generated vibrations can damage underground and aboveground structures. When the Contractor is using a seismograph to monitor vibrations, the Standard Specifications (§ 203-3.05 C) specify the maximum particle velocity allowed at the nearest structure on NYSDOT ROW. In the absence of seismic monitoring equipment, the explosives loading limits shall be based upon the scaled distance formula in the Standard Specifications. Local regulations and the Contractor's insurance company may require seismic monitoring of buildings off the ROW. In certain circumstances, NYSDOT may also require monitoring of adjacent buildings. Even when vibrations are not at a level sufficient to cause damage, they can disturb individuals and result in complaints. Proper placement and operation of the seismograph is critical for obtaining accurate readings. Vibrations can be controlled by modifying the weight of explosives per delay, the loading density, and the delay pattern. A preblast condition survey of a structure may be required prior to blasting to document the preblast condition of the structure.

3. Displacement of Bedrock

Blasting, primarily trench and ditch blasting, can displace rock and damage adjacent pavement and underground utilities.

4. Noxious Fumes

Blasting generates carbon monoxide and other noxious fumes. The fumes generated during blasting operations, especially during trenching operations, can migrate and collect in excavations, structures like manholes and D.I.'s, and nearby buildings. The build up of significant concentrations of gases can occur 12 hours or more after the blast. All blasting shall be conducted so that the noxious gases generated by the blast do not affect the health and safety of individuals.

When site conditions and blasting procedures indicate that there is the potential for the migration and accumulation of gases, the Contractor should specify information collection activities, modification of blasting procedures, and an action plan in the event of a high reading or alarm. Such site conditions could include but are not limited to: open jointed bedrock (i.e. karstic limestone); an impermeable soil layer overlying the bedrock (i.e. clay or saturated soil); and proximity to buildings. Blasting procedures that may increase the risk include confined (i.e. trenching), large, and frequent blasts. Information collection activities should include preblast surveys of all buildings, within a minimum of 100 meters of the blast, that would identify potential sources of entry and potential pathways to the buildings, such as buried utility trenches. Information collection activities should also include monitoring of carbon monoxide levels before, during, and after the blast. Modification of blasting procedures should include limiting the size and frequency of blasts to limit the production of noxious fumes, and stripping of the overburden prior

to blasting and excavating the shot rock immediately after blasting to allow the venting of gases. The use of vent holes or vent pits may also be necessary. The action plan should cover both building occupants and monitoring personnel.

5. Air Blast Overpressure

Although unusual, blasting generated air waves can reach a level where they can damage buildings. Air waves not at a level sufficient to cause damage can disturb individuals, resulting in complaints. Factors that affect air blast overpressure include topography, blast design, and atmospheric conditions. Blasts may have to be redesigned or rescheduled for more favorable atmospheric conditions to minimize air waves.

C. Definitions

Airblast - The airborne shock wave generated by an explosion.

ANFO – A blasting agent composed primarily of ammonium nitrate and fuel oil.

Backbreak – Rock broken beyond the limits of the last row of holes in a blast, synonymous with overbreak.

Base Charge – The main explosive charge in the base of a detonator or a heavy charge at the base of a column of presplit powder.

Battered Production Holes – The row of production holes closest to presplit line, drilled at the same angle as the presplit holes.

Bench – A horizontal ledge from which holes are drilled downward into the material to be blasted.

Binary Explosive – A blasting explosive formed by the mixing of two phosphoric materials, for example, ammonium nitrate and nitromethane.

Blast Pattern – The plan view of the drill holes as laid out for blasting.

Blaster of Record – The project blaster in charge of a specific blast. *A project may have several project blasters, but only one blaster is in charge of each blast.*

Blasting Agent – An explosive material, consisting of fuel and oxidizer, that cannot be detonated with a No. 8 blasting cap.

Blasting Area/Zone – An area near any blasting operation in which concussion, flying material or debris, or gases resulting from a detonation of explosives can reasonably be expected to cause

injury or property damage.

Blasting Galvanometer – An electrical resistance instrument designed specifically for testing electrical continuity of electric detonators and circuits containing them. Other acceptable instruments for this purpose are Blasting Ohmmeters and Blaster's Multimeters.

Blasting Mat – A Mat of woven steel wire, scrap tires, or other suitable material to cover blastholes for the purpose of preventing flyrock.

Blasting Vibrations – The energy from a blast that manifests itself in the form of vibrations which are transmitted through the earth away from the immediate blast area.

Booster – An explosive charge, usually of high detonation velocity and detonation pressure, designed to be used in the explosive initiation sequence between an initiator or primer and the main charge.

Bulk Strength – The strength per unit volume of an explosive calculated from its weight strength and density.

Burden – The distance from the borehole to the nearest free face or the distance between boreholes measured perpendicular to the spacing.

Certified Blaster – An individual whose has been issued a "Certificate of Competence for Blaster" by the NYS Department of Labor for using explosives.

Collar – The mouth or opening of a borehole.

Column Charge – A long, continuous, unbroken column of explosives in a blasthole.

Continuity Check (Circuit) – A determination that an initiation system is continuous and contains no breaks or improper connections that could cause stoppage or failure of an ignition system. For an electric initiation system, the check is performed both visually and by using a blasting galvanometer or other device. For a non-electric initiation system, the check can only be done visually.

Deck Loading (Decking) – A method of loading blastholes in which the explosive charges, called decks or deck charges, in the same hole are separated by stemming or an air cushion. The separate decks may or may not be fired on the same delay.

Deflagration – An explosive reaction such as a rapid combustion that moves through an explosive material at a velocity less than the speed of sound in the material.

Delay Blasting – The practice of initiating individual explosive decks, boreholes, or rows of

boreholes at predetermined time intervals using delay detonators, or other delaying methods, as compared to instantaneous blasting where all holes are fired essentially at the same time.

Delay Detonator – An electric or nonelectric detonator used to introduce a predetermined lapse of time between the application of a firing signal and the detonation of a charge.

Departmental Engineering Geologist – An Engineering Geologist of the Geotechnical Engineering Bureau authorized by the Director of the Geotechnical Engineering Bureau to perform the duties required under the NYS DOT Standard Specifications.

Design Rock Slope – A cut slope in rock constructed at the angle and location specified in the contract plans. Presplit blasting is usually used to construct the slope so that the finished slope is stable and free from significant rock hazards.

Detonating Cord – A flexible cord containing a center core of high explosives which may be used to initiate other high explosives.

Detonating Cord Trunkline – The line of detonating cord that is used to connect and initiate other lines of detonating cord.

Detonation – An explosive reaction that moves through an explosive material at a velocity greater than the speed of sound in the material.

Detonator – Any device containing an initiating or primary explosive that is used for initiating detonation in another explosive material.

Drilling Pattern – The location of blast holes in relation to each other and the free face.

Dynamite – A high explosive used for blasting, consisting essentially of a mixture of, but not limited to nitroglycerin, nitrocellulose, ammonium nitrate, sodium nitrate, and carbonaceous materials.

Electric Blasting Circuit – An electric circuit containing electric detonators and associated wiring.

Electric Detonators – A detonator designed for, and capable of, initiation by means of an electric current.

Emulsion – An explosive material containing substantial amounts of oxidizer dissolved in water droplets, surrounded by an immiscible fuel; or droplets of an immiscible fuel surrounded by water containing substantial amounts of oxidizer.

Explosion – A chemical reaction involving an extremely rapid expansion of gases usually

associated with the liberation of heat.

Explosive – Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion.

Explosives License – Own & Possess – A license issued by NYS Department of Labor for the purpose of purchasing, owning, possessing, or transporting explosives.

Explosive Loading Factor – The amount of explosive used per unit volume of rock. Also called Powder Factor.

Explosive Materials – These include explosives, blasting agents, and detonators. The term includes, but is not limited to, dynamite and other high explosives; slurries, emulsions, and water gels; black powder and pellet powder; initiating explosives; detonators (blasting caps); and detonating cord.

Extra (Ammonia) Dynamite – A dynamite in which part of the nitroglycerin is replaced by ammonium nitrate in sufficient quantity to result in the same weight strength.

Extraneous Electricity – Electrical energy, other than actual firing current or the test current from a blasting galvanometer, that is present at a blast site and that could enter an electric blasting circuit. It includes stray current, static electricity, RF (electromagnetic) waves, and time-varying electric and magnetic fields.

Flyrock – Rocks propelled from the blast area by the force of an explosion.

Fragmentation – The breaking of a solid mass into pieces by blasting.

Free Face – A rock surface exposed to air or water which provides room for expansion upon fragmentation. Sometimes called open face.

Fuel – A substance which may react with oxygen to produce combustion.

Fumes – The gaseous products of an explosion. For the purpose of determining the fume classification of explosive material, only poisonous or toxic gases are considered.

Gelatin Dynamite – A type of highly water resistant dynamite characterized by its gelatinous or plastic consistency.

Geology – A description of the types and arrangement of rock in an area; the description usually includes the bedding dip and strike, the type and extent of pre-existing breaks in the rock, and the hardness and massiveness of the rock, as these affect blast design.

Grains – A weight measurement where 7000 grains are equivalent to 0.45 kg (1.0 lb.).

Ground Vibration – Shaking the ground by elastic waves emanating from a blast. Usually measured in mm/s (in/s) of particle velocity.

High Explosives – Explosives which are characterized by a very high rate of reaction, high pressure development, and the presence of a detonation wave in the explosive.

Initiator – A detonator, detonating cord or similar device used to start detonation or deflagration in an explosive material.

Lift – The vertical thickness of rock fragmented from a single blast.

Loading – Placing explosive material in a blast hole or against the material to be blasted.

Loading Density – The weight of explosive loaded per unit length of borehole occupied by the explosive, expressed as kilograms/meter of borehole.

Loading Limits – The maximum quantity of explosives allowed per delay period as specified by the Standard Specifications.

Loading Pole – A nonmetallic pole used to assist in placing and compacting explosives charges in boreholes.

Low Explosives – Explosives which are characterized by deflagration or low rate of reaction and the development of low pressure.

Magazine – Any building, structure, or container approved for the storage of explosives materials.

Mass Explosion – An explosion which affects almost the entire load or quantity of explosives virtually instantaneously.

Maximum Particle Velocity (Peak Particle Velocity) – The maximum velocity at which the ground surface moves as a wave passes under it. The customary practice is to apply vibration limits to the peak particle velocity of the largest single component on the seismograph.

Millisecond (ms) – One thousand part of a second (.001 or 1/1000 sec.).

Misfire – A blast or specific borehole that failed to detonate as planned. Also the explosive materials that failed to detonate as planned.

Muckpile – The pile of broken material resulting from a blast.

Nitroglycerin – An explosive chemical compound used as a sensitizer in dynamite.

Nonelectric Detonator – A detonator that does not require the use of electric energy to function.

Nonsparking Metal – A metal that will not produce a spark when struck with other tools, rock, or hard surface.

Overbreak – See backbreak.

Overburden – Material of any nature laying on top of the rock that is to be blasted.

Oxidizer – A substance, such as nitrate, that readily yields oxygen or other oxidizing substances to promote the combustion of organic matter or other fuel.

Particle Velocity - The velocity at which the ground surface moves as a wave passes under it.

PETN – A abbreviation for the name of the high explosive pentaerythritol tetranitrate.

Placards – signs placed on vehicles transporting hazardous materials (including explosive materials) indicating the nature of the cargo.

Phosphoric Materials – Two or more unmixed, commercially manufactured, prepackaged chemical materials which are not classified as explosives but which, when mixed or combined, form a blasting explosive.

Powder Factor – The amount of explosive used per unit volume of rock. Also called Explosive Loading Factor.

Preblast Survey – A documentation of the preexisting condition of structures near an area where blasting is to be conducted.

Premature Firing – The detonation of an explosive charge before the intended time.

Presplitting – A blasting method in which cracks for the final contour or payline are created by firing a single row of holes containing light, well distributed charges, prior to the initiation of the remaining holes in the blast pattern.

Prilled Ammonium Nitrate – Ammonium nitrate in a pelleted or prilled form.

Primer – An explosive charge used to initiate other explosives or blasting agents. The primer is initiated by a detonator or detonating cord to which is attached a detonator.

Production Blasting – A blasting method whose sole purpose is to fragment the rock.

Propagation – The detonation of an explosive charge by an impulse received from an adjacent or nearby explosive charge.

Project Blaster(s) – A certified blaster who has been approved to blast on NYSDOT ROW.

Relief – The effective distance from a blast hole to the nearest free face (synonymous with burden).

Round – A group of boreholes fired or intended to be fired in a continuous sequence.

Scaled Distance – A factor relating expected vibration levels from various weight charges of explosive materials at various distances.

Secondary Blasting – Blasting to reduce the size of boulders resulting from a primary blast.

Seismograph – An instrument which records ground vibrations generated by blasting operations. Particle velocity displacement is generally measured and recorded in three mutually perpendicular directions.

Sensitivity – A physical characteristic of an explosive material classifying its ability to be initiated upon receiving an external impulse such as impact, shock, flame, friction, or other influence which can cause detonation.

Shaped Charges – An explosive with a shaped cavity, specifically designed to produce a high velocity cutting or piercing jet of product reaction; usually lined with metal to create a jet of molten liner material. They are generally used to cut steel members during superstructure demolition.

Shock Tube – A small diameter plastic tube used for initiating detonators. It contains only a limited amount of reactive material so that the energy that is transmitted through the tube by means of a detonation wave is guided through and confined within the walls of the tube.

Short Delay Blasting – The practice of detonating blastholes in successive intervals where the time distance between any two successive detonations is measured in milliseconds.

Slurry – An explosive material containing substantial portion of a liquid, oxidizers, and fuel, plus a thickener.

Stemming – Inert material placed in a borehole on top of or between separate charges. Used for the purpose of confining explosive gases or to physically separate charges of explosive material in the same borehole.

Subdrilling – The practice of drilling boreholes below floor level or working elevation to insure breakage of rock to working elevation.

Sympathetic Detonation – The detonation of an explosive material as the result of receiving an impulse from another detonation through air, earth, or water. Synonymous with sympathetic propagation.

Tamping – The action of compacting the explosive charge or the stemming in a blasthole. Sometimes refers to the stemming material itself.

Warning Signal – An audible signal which is used for warning personnel in the vicinity of the blast area of the impending explosion.

Water Gel – An explosive material containing substantial portions of water, oxidizers, and fuel, plus a cross-linking agent.

Water Resistance – The ability of an explosive to withstand the desensitizing effect of water penetration.

Weight Strength – The energy of an explosive material per unit of weight.

II. PROCEDURE FOR BLASTING WITHIN NYSDOT ROW

A. Submittal of Written Blast Plan

Prior to scheduling the preblast meeting, a written blast plan prepared by the blaster shall be submitted by the Contractor to the Engineer a minimum 10 working days in advance for conditional approval. The Engineer shall send a copy of the blast plan to the Regional Geotechnical Engineer who shall forward a copy to the Geotechnical Engineering Bureau, Engineering Geology Section for review and written comment. The blast plan may be returned to the blaster for revision or clarification prior to scheduling the preblast meeting. The blast plan shall include all steps necessary to ensure that the proposed blasting activity does not cause injury, damage property, adversely affect traffic, or cause the migration/accumulation of noxious gases. The blast plan shall include the following items:

1. Project Designations

- Name of project blaster(s).

- Photocopy of the blaster's Explosives License (Own & Possess) and Certificate of Competence.
- Is the blaster an employee of the Contractor or a subcontractor?
- Scheduled start date and length of blasting operations and blast monitoring operations.
- Limits of blasting work.
- Are local permits required and if so, have they been obtained?
- Location of any State owned structures in proximity to the blasting.
- Location of any utilities in proximity to the blasting.

2. Safety and Health Requirements

- What type of audible warning signals and signal sequence?
- Who will deliver explosives and will on site storage be requested?
- Will preblast surveys be performed and where?
- Will vibrations be monitored at State owned structures, utilities on or off our ROW, or privately owned structures off our ROW?
- Will air blast overpressures be monitored?
- If seismographs will be used, the manufacture's name, model number, and documentation of calibration performed within the last 12 months will be provided.
- What steps will be taken to control flyrock (i.e. blasting mats)?
- Are carbon monoxide or other noxious fumes a concern and if so, how will they be addressed?

3. Methods and Procedures

- Type of drilling equipment.
- Method of collaring and aligning presplit drill holes.

- Hole diameter.
- Drilling pattern.
- Use of sequential timer.
- Type of explosives (manufacturer, product type, dimensions, and weight per stick).
- Type of blasting caps (manufacturer, product type, and delays).
- Loading parameters:
 - A. Maximum and/or average weight of explosives per volume of rock.
 - B. Maximum weight of explosives per delay.
- Blasting cap delay patterns.

B. Scheduling Preblast Meetings

After the blast plan is approved, the Engineer should contact the Engineering Geology Section via the Regional Geotechnical Engineer to schedule the meeting. The Contractor, having been informed of the date, time, and location of the meeting, is responsible for inviting the blaster (all blasters whom the contractor wants to be designated as project blasters must attend the meeting) and all interested parties (including but not limited to utilities, railroads, local political jurisdictions, local law enforcement agencies, and local emergency services) a minimum of 3 work days in advance of the meeting. Utility representatives for all utilities located within 60 meters of the blasting (90 meters for gas transmission lines) shall be invited.

C. Conducting Preblast Meetings

A preblast meeting shall be held at the site to discuss the proposed blasting operations. In attendance will be the Engineer, the Contractor, the Project Blaster, an Engineering Geologist from the Geotechnical Engineering Bureau, and other interested parties. Final approval to blast will be granted based upon the results of the meeting.

D. Inspection and Documentation

An Engineering Geologist will be available to train construction inspection staff in the proper method of inspecting blasting operations including ensuring that the blasting is carried out in a safe manner and documenting each blast using the Blasting Report Form GE 469 MET (2/00) (see Appendix A).

E. Test Blasts

Test sections are required for presplit slopes and test blasts may be required for other types of blasting situations. An Engineering Geologist will be available to provide assistance during the test blasts and determine if adjustments to the blasting operations are necessary.

F. Additional Preblast Meetings

A new preblast meeting will be required to designate new project blasters.

G. Blasting Review

If a blast causes injury, damage to property, adversely affects traffic, or causes gases to migrate and/or accumulate in a potentially harmful manner, all blasting operations shall cease for a review of the procedures. The review will be conducted by the Engineer in conjunction with an Engineering Geologist from the Geotechnical Engineering Bureau to ensure proper procedures and practices were used and to determine if the approved procedures need to be revised. Should the findings of the review indicate the injury, damage, traffic delay, or migration/accumulation of gases was attributed to improper blasting operations, the blaster of record may be removed at the State's option.

B. Instructions for Filling Out the Blasting Report Form (GE 469 MET)

Heading Data

- Job Stamp - Imprint job stamp under "Job Stamp".
- E.I.C. - Enter the name of the Engineer In Charge.
- Inspector - Enter the name of the state or consultant blast inspector.
- Blaster - Enter the name of the blaster of record.
- Report No. - Sequentially number from 1, beginning with the first blast detonated.
- Date - Enter the date of the blast. If the shot is loaded one day and detonated the next, enter the date of the detonation.
- Time - Enter the actual time and date (if different from loading) the blast is detonated (Hr. & Min).

Shot Hole Data

- Station Limits - Enter the stations of the beginning and end of the presplit holes to be detonated if presplit is involved. Do the same for production holes, if production only is loaded.
- No. & Diameter - Enter total number of presplit holes & diameter. Do the same for production holes.
- Spacing/Pattern - Maximum one meter on center for presplit holes. For production pattern enter average distance between holes in rows and average distance between rows (Spacing X Burden) in meters.
- Depth - Enter range of depth to grade next to "To Grade", enter depth of overdrilling next to 'Overdrilling' (meters).
- Total Depth - The sum of 'To Grade' & 'Overdrilling' = total depth. Because 'to grade' and 'overdrilling' are usually ranges, 'total depth' will usually be a range also.
- Stemming - Depth in meters, from top of drill hole to top of explosives. For presplit holes it's required that the presplit powder be within one meter of the ground surface and the entire hole stemmed.

Type - It's required that No. 1-A crushed stone be used for stemming presplit holes. Production holes can be stemmed with drill cuttings or soil as long as it's effective.

Explosive and Detonation Data

Producer - Enter the manufacturer of each explosive (base charge, column charge, production explosive & blasting agent). Examples are Dyno Nobel and Austin.

Type - Enter the manufacturer's product name of each in the appropriate column. Also enter the strength percentage (40%, 60%, etc.) as on the container. Examples are Dynosplit and Unimax.

Dimension - Enter diameter and length of the individual cartridges in the appropriate columns.

Weight - Enter weight per stick of base charge, weight/meter of presplit powder, weight per stick of production charges & weight of column for blasting agent. All weight is in kilograms.

Total weight - Enter the sum total for each type of explosive, base charge, column charge, production explosive & blasting agent.

Initiation (Type) - Enter 'electric blasting (EB) caps' or 'non electric blast (NEB) caps' or other method as used. List cap manufacturer brand and series.

Delays - Enter the number of different delay periods used. Period(s): enter the delay periods used. Examples are: electric – 25,75,100 ms; nonelectric – 25/350, 25/500 ms.

Max. kg/Delay - Add the weight of explosives on each different delay per blast. The greatest weight of explosives detonated per delay is the max. kilograms/delay at 25 ms or 75 ms or 250 ms, etc.

Presplit Check List

Before Loading any holes with explosives

1. The Blaster must designate P-S holes in the section to be loaded.
2. Back up from end and designate the production section to be loaded.

3. Check all P-S holes for obstruction and clear all P-S holes before loading any P-S or production powder.

Holes Tested for Obstructions **G** - check the box only after all presplit holes have been tested for clearance with either loading poles, measuring tape or some other device which can assure that the holes are clear to the full drilled length. If not, then the hole is obstructed and must be cleared.

Burden +1 meter (or _____) Loaded Ahead **G** - check the box only after it has been determined that the presplit line is loaded with explosives a length which equals the burden + 1 meter past the closest production hole to the end of the presplit line. Usually this works out to 3 presplit holes. No production holes can be loaded past a perpendicular line to the presplit line from the third hole back.

Fired 25 MS ahead **G** - Presplit holes must be detonated a minimum of 25 MS ahead of the production holes in that section.

Only Cartridges within 3 meters of Slope **G** - No uncontained or poured explosives are allowed in holes within 3 meters of the presplit plane.

Remarks - Utilized this area to report on the results of the blast, i.e. damage/no damage, cutoffs, flyrock, road closed, traffic delay, seismograph locations and readings, carbon monoxide monitor locations and readings, etc.

Ignition Pattern- Utilize this area to draw an accurate plan view of drill holes, including:

- a. edge of rock
- b. north arrow
- c. station and offset of beginning and end of presplit line
- d. hole numbers
- e. spacing
- f. burden
- g. timing of initiation of each hole (adjusted to sequential timer if one is used. Diagram wiring connections).
- h. important geologic features, i.e., seams, boulders, etc.
- i. hole depths and kg of explosives per hole & per deck, if used
- j. show detonation cord type & location

C. Highlights from State and Federal Safety Regulations

Transportation of explosives (12 NYCRR 39; 49 CFR 177; 29 CFR 1926 Subpart U)

- A vehicle carrying explosives shall not be left unattended or unguarded. Someone able to move the vehicle, familiar with the hazards of the material being transported and who knows what to do in an emergency must be awake in the vehicle or within 100 feet of the vehicle and have it in clear view.
- It is prohibited to park within 300 feet of a bridge, tunnel, building, a place where people gather, or an open fire unless absolutely necessary to perform their work.
- The vehicle shall not be parked within 5 feet of a traveled roadway.
- The vehicle shall make no unnecessary stops.
- Explosives shall be loaded/unloaded only when engine is off and parking brake is set.
- Do not travel through congested areas or heavy traffic unless it is a designated route.
- No device or material capable of producing spark, flame or heat shall be placed or carried on a vehicle containing explosives.
- Proper placards are required on both sides and the front and back of the vehicle.
- Fire extinguishers required with a rating of at least 10: ABC. If carrying 200 lbs. or more of explosives, two 10 to 12 lbs. carbon dioxide fire extinguishers or two 4 to 7 lbs. dry chemical fire extinguishers are required.
- Explosives shall not be transported on a trailer and a vehicle carrying explosives shall not have a trailer in tow.
- The sides and ends of an open-ended vehicle shall be high enough to prevent packages of explosives from falling off the vehicle and the explosives shall not be stacked higher than the sides of the vehicle.
- Up to 50 detonators may be carried on a vehicle containing explosives provided that: the detonators are in their original shipping containers, or a box constructed of one inch lumber lined with padding not less than ½ inch thick or wrapped in cloth with cloth separating each detonator, and the detonators must be in a place remote from the explosives that is easily accessible for quick removal.
- Exposed ferrous metal on the vehicle body that may come in contact with the explosive

packages must be covered with wood or other non-ferrous material.

Explosive safety and handling (29 CFR 1926 Subpart U)

- Smoking, firearms, matches, open flames lamps, flames, heat producing devices and sparks are prohibited in or near magazines or while explosives are being handled, transported or used.
- All explosives must be accounted for at all times. Explosives not in use shall be in a locked magazine.
- Explosives or blasting agents shall not be abandoned.
- Original containers or class II magazines shall be used for the transport of detonators and explosives from storage to the blasting area.
- Blasting operations above ground shall be conducted between sunup and sundown.
- Electric detonators shall be short-circuited and shunted in holes which have been primed until wired into the blasting circuit.
- Blasting operations shall be suspended and personnel shall leave the blasting area upon the approach and progress of an electrical storm.
- Blasting zone signs and signs warning against the use of mobile radio transmitters must be posted on all roads within 1000 feet of the blasting area.
- Mobile radio transmitters which are less than 100 feet from electric blasting caps shall be deenergized and effectively locked.
- Empty boxes and paper and fiber packing materials, which have previously held explosives, shall not be used for any purpose and shall be destroyed by burning.
- Blasting operations in the vicinity of overhead power lines, communication lines, utilities, or other services and structures will not be carried out until the Utilities are notified and measures for safe control have been taken.
- Use of black powder is prohibited.
- Smoking and open flames are not permitted within 50 feet of explosives and detonator storage magazines.
- Tamping will be done with wood rods or plastic tamping poles without exposed metal parts. No violent tamping is allowed.

- After loading holes, all unused explosives and detonators must be returned to an authorized magazine.
- No person will be allowed to deepen drill holes which have previously contained explosives or blasting agents.
- Equipment will not be operated within 50 feet of loaded holes (no drilling digging, etc.).
- Electric cables in the proximity of the blast area shall be deenergized and locked out.
- Holes will be checked prior to loading to determine depth and conditions of the hole.
- No drilling is allowed within 50 feet of a hole that has been loaded with explosives and has failed to detonate.
- All blast holes will be stemmed to the collar or a point that will confine the charge.
- Blasting cap leg wires will be kept short-circuited (shunted) until they are connected into the circuit for firing.
- A code of blasting warning signals (29 CFR 1926) shall be posted conspicuously at the operation and all employees shall be familiar with the signals.
- A loud signal must be given by the blaster of record prior to firing the blast.
- Flaggers must be safely positioned on roadways passing through the danger zone to stop traffic during the blasting operations.
- Following the blast, the blasting machine or other initiation devices shall be disconnected from the firing line or turned off in the case of power switches.
- The blaster shall check the surrounding rubble and blasting area to determine that all charges have been exploded.
- If a misfire occurs, only those employees necessary to do the work shall remain in the blast zone.
- No attempt will be made to extract explosives from any charged or misfired hole. A new primer shall be installed and the hole reblasted. If refiring the hole is a hazard, the explosives may be removed by washing out with water.
- No drilling, digging, or picking will be permitted until all missed holes have been detonated.

Explosive licensing (12 NYCRR 39)

- To purchase, transport, own and possess explosives, an explosives license is required.
- The handling and placing of explosives in preparation of a blast shall be performed by a certified blaster or by persons under the supervision of a certified blaster.
- Only a certified blaster may detonate explosives.

Explosive storage (12 NYCRR 39, 29 CFR 1926 Subpart U)

- Magazines and all enclosures used for storage of explosives shall be kept locked.
- Inventory of explosives shall be taken at the end of the day after blasting operations or whenever the magazine is opened.
- Magazines shall be inspected at least every 3 days.
- No smoking or flames are allowed within 50 feet of any explosive or magazine.
- No blasting equipment shall be stored in a magazine.
- Separate magazines shall be provided for explosives and detonators.
- No lights in magazine except battery activated electric flashlights or electric lanterns enclosed in rubber or other insulating cover.
- Ground around the magazine for a distance of 25 feet must be kept clean of flammable debris such as dry leaves and grass.
- No discharge of firearms at or within 500 feet of a magazine.
- Magazines must be located certain distances from buildings, railways, highways and other magazines based on the quantity of explosives stored in the magazine.
- The distances of separation can be decreased by 50% if the magazine or other structure containing explosives is protected by an efficient barricade.
- Explosive quantity conversion of detonators and detonating cord.
 - Cap size up to and including #8: 1000 caps are rated equivalent to 1.5 lbs. of explosives.

- Cap size larger than #8: 1000 caps are rated equivalent to 3 lbs. of explosives.
- Detonating cord up to and including 60 grains/foot: 1000 feet is rated equivalent to 9 lbs. of explosive.
- Detonating cord above 60 grains/foot: 1000 feet is rated equivalent to 15 lbs. of explosives.

Underground utilities (12 NYCRR 53)

- Underground facilities within 15 feet of a proposed excavation or demolition must be staked, marked or otherwise designated.
- Verification shall be accomplished by exposing the underground facility or its encasement to view or by other means mutually agreed to by the excavator and operator.
- Powered equipment shall not be used within 4 inches of the verified location of an underground facility.