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Drill/Blast Testing Alternatives for Matilija Dam Concrete Removal Methods Evaluation /Demonstration Project

AE00-54; Project Number 81912

June 23, 2000

Prepared For

VENTURA COUNTY FLOOD CONTROL DISTRICT

By

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Principal Consultant

GEOTEK

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1.0 INTRODUCTION

GEOTEK & Associates, Inc. (GEOTEK), an independent blast-engineering services company, was retained by the Ventura County Flood Control District (VCFCD) to develop drilling and blasting alternatives for a test program intended to evaluate various methods for sectioning and removing mass concrete at Matilija Dam near Ojai, California.

Specifically, GEOTEK has been directed to perform the following tasks:

Task no. 1 – Visit site to inspect condition of the dam and learn the proximity of nearby water resources, structures, utilities and private buildings.

Task no. 2 – Preparation of two drill-blasting plan alternatives for sectioning thirty feet or, less of the remaining Ogee spillway on the East Side of the Matilija Dam. First alternative will assume existing cracking to be superficial. The second alternative will entail a contingency plan only if cracking is significant, and will not allow the sectioning to be done as whole.

Task no. 3-Provide draft plan alternatives for review and comment. Alternatives will include draft DXF format drawings.

Task no. 4- Prepare plans including scope of work and specifications needed to direct the work of the contractor performing the evaluation for drill-blasting. Specifications will include guidelines and, or restrictions concerning the environmental impacts for blasting, including but not limited to blast-induced vibration and monitoring, air-overpressure near the dam, drilling and blasting dust mitigation, explosive type and handling methods, safety issues related to drill-blasting, etc.

Task no. 5-Preparation of a cost estimate for each alternative.

Task no. 6-Submit draft plan & specifications for review & comments.

Task no. 7- Assist in the evaluation phase of the project by providing consulting review of drill-blasting operations by contractor.

On May 15, 2000, Gordon F. Revey of GEOTEK, the report's author met Sergio Vargas—a senior VCFCD engineer at the Matilija Dam. During this site visit, the author studied the proposed ogee test area, inspected the condition of the concrete and evaluated the proximity of structures and utilities located near the work area.

This purpose of this report is to provide all information required in tasks 2 through 6 identified in the preceding scope of work.

2.0 DRILL/BLAST ALTERNATIVES FOR CONCRETE SECTIONING TESTS

For many years, quarries and contractors have used special controlled drilling and blasting methods to create dimension stone for commercial use and in some cases, to section concrete into manageably-sized blocks to facilitate its removal. This form of blasting to create stone blocks for monuments or for cutting into slabs with saws is called "loaf blasting."

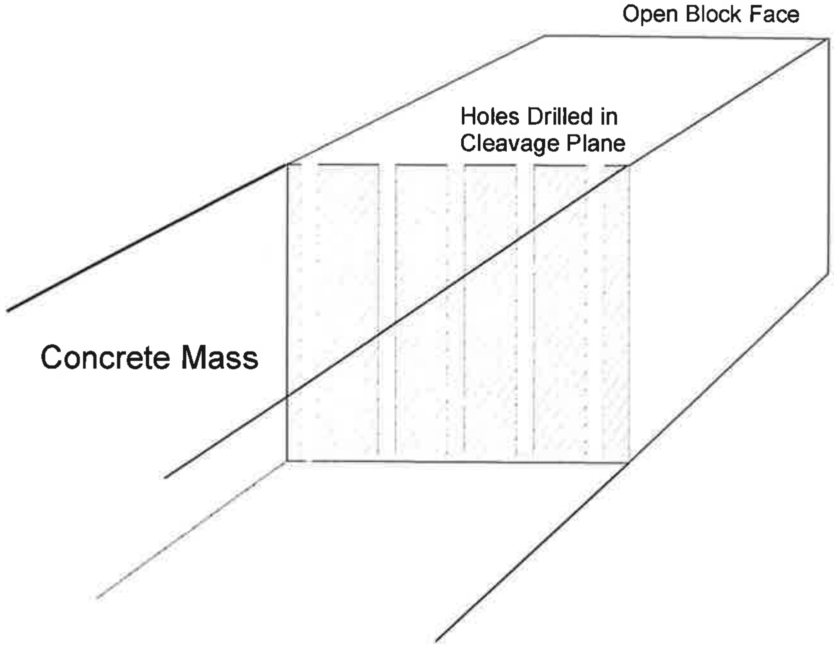
In 1977, a ship collided with a large concrete bridge pier on the James River near Hopewell, Virginia. A subsequent inspection revealed that the bridge pier was extensively damaged and would need to be removed to allow reconstruction. A controlled drilling and blasting technique utilizing closely-spaced (12-in) drill holes charged with 200-grain detonation cord was successfully used to section the pier into large blocks that were later removed by a crane working from a barge in the river. Some of the concrete blocks weighed as much as 150 tons. A case-history technical paper describing this work, written by D.H. Matthews—the blasting contractor—is included in Attachment 3 of this report.

2.1 Dimension Blasting Methods Review

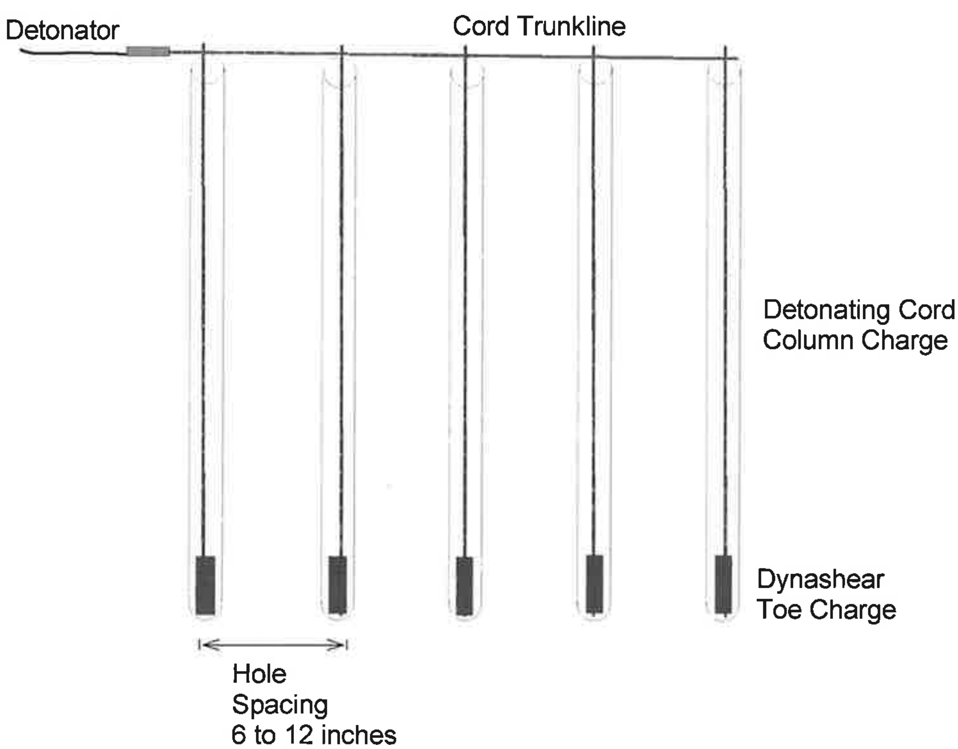
Various forms of low-energy or decoupled explosives loaded within tightly-spaced holes drilled within desired cleaving planes are used to separate blocks of stone or concrete from larger rock masses or concrete monoliths. Special low-velocity dynamites like "Dynashear" are used by some operations, while others use charges made from highly energetic—but very small-diameter detonating cord containing core loads of Pentaerythritoltetranitrate, [PETN $\{C_5H_8(NO_3)_4]$. Core loads used for dimension blasting range from 18 to 400 grains/foot. Note that there are approximately 7,000 grains/pound—so these are extremely light charges. However, PETN detonating cords have a very high velocity of detonation (VOD), usually about 25,000 ft/s. Data sheets for Dynashear and typical detonating cords are given in Attachment 2.

Whether cord or low-energy explosives like Dynashear (a low energy dynamite made by Orica, Inc.) are used, the goal is to create charges generating just enough pressure to cleave the web of rock between the blasted holes. In hard granite, the desired pressure is between 200 and 300 psi. Since the dynamic tensile strength of concrete is much less than that of concrete, lower pressure is generally needed to crack it. If borehole pressures are too high, secondary radial cracks often occur in the cleaved block. Borehole pressure can be controlled by the degree of charge confinement or decoupling. For instance the energy of a 0.25-inch cord charge in a 2.5-inch blasthole is greatly buffered when the gasses from the detonation expand into the annulus around the charge. The degree of borehore pressure can also be adjusted by varying the medium surrounding the charge. An annulus of compressible air will lessen the pressure the most, followed by sand and lastly water. A new annulus filling material called B-Gel, made by mixing water with collapsible microspheres can also be used to control peak borehole pressures and to extend the time range of applied pressure. Plugging hole-collars with tamped clay can also increase the pressure produced by charges surrounded with an air annulus or sand filled stemming bags.

TYPICAL CONCRETE-SPLITTING BLAST SCHEME

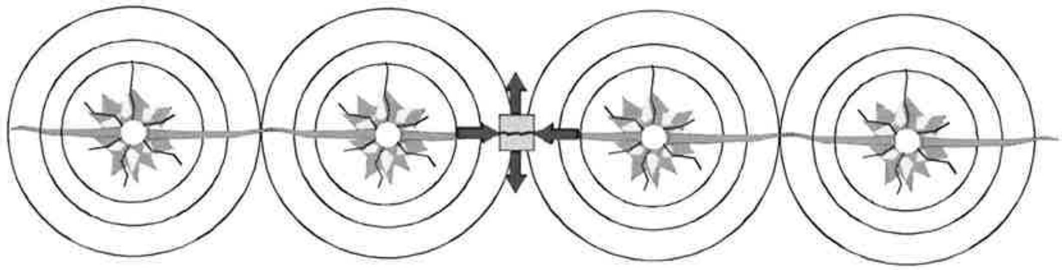


TYPICAL LOADING



Shear blasting works best when charges are fired simultaneously in order to create preferential tensile loading of the concrete within the cleavage plane. In some applications where vibration restrictions prevent firing all the holes at one time, groups of holes can be separated by short millisecond delays (8 to 17 ms) without any adverse effect on the splitting mechanics.

SPLITTING MECHANICS



Simultaneously Detonating Charges create a high tangential tensile stress that preferentially causes radial crack extension between charged holes. Blast gasses expand into the crack and finish the cleaving effect.

3.0 GOALS OF BLASTING TESTS AT THE MATILIJA DAM

As understood by GEOTEK, VCFCD wishes to evaluate practical methods for sectioning concrete at the Matilija Dam into blocks that can be lifted off the Dam with a crane for transport to a disposal area. The weight of the blocks should not exceed 50 or so tons. It is also important to find methods whereby broken concrete, drill cuttings, oils, lubricants and any other materials will not pollute the water in Matilija Creek, which is habitat for steelhead trout and other waterborne fauna. In essence, the dam will be removed to improve the environmental habitat, so it is critical for the work to occur with minimal impacts. Moreover, all evaluated methods must be safe and practical. Another important aspect of this test work is to collect data for evaluating the relative cost of the various test methods.

4.0 BLASTING ISSUES AND CHALLENGES

There is little doubt that blasting methods can be used to break concrete. However, the greatest challenge at the Matilija Dam will be finding ways to prevent overbreaking the concrete so it can be contained in manageably-sized block that can be lifted off the Dam by a crane. Large clearly visible surface cracks in the concrete--particularly near the top of the Dam—indicate the condition of the concrete has deteriorated over time. It is not known if these cracks penetrate deeply within the concrete. For the purposes of this test plan, GEOTEK has assumed that the cracks might cause the concrete blocks to break into pieces defined by existing cracks. Based on this assumption, GEOTEK recommends that before blocks are blasted, they be wrapped with some form of wire mesh secured with 2-foot mechanical rock bolts and metal washer plates. This form of "jacketing" will ensure that all pieces of the broken blocks will stay on the Dam when blasted.

When drilling rock or concrete, water is usually pumped through drill rods to create a drill-cuttings-slurry that is ejected out of hole-collars. The thickness of the slurry can be adjusted by metering the amount of drill water. Drilling can also be done with no water but this creates environmental and health concerns due to the large amounts of resulting airborne dust. It will probably be best to create a thick cuttings-slurry by using minimal drill water and require the contractor to use some form of vacuum device to suck up the cuttings as they are ejected from the hole-collars during drilling. Industrial 20-gallon shop vacuums or more rugged industrial vacuum equipment could be used for this purpose.

Controlling noise and vibration is often an important issue for construction blasting work. Fortunately, due to the relative remoteness of the dam and the small scale of the blasting, controlling vibration effects at the Dam's structures should not be too difficult. Blast-induced vibration will not be felt at the nearest dwelling about 2,500 feet downstream from the Dam. Some noise and air overpressure effects may be noticeable at this residence but they will not cause any damage. For the test blasts, GEOTEK recommends monitoring these effects at the nearest rock abutment of the Dam and at the nearest dwelling located on Matilija Hot Springs Road. This data could be used to establish air overpressure and vibration intensity attenuation characteristics for the site.

5.0 PROPOSED CONCRETE QUARRYING METHOD

Before describing methods for breaking the concrete into blocks, GEOTEK believes it would be helpful to describe how a quarry-like mining scheme would be used to deconstruct the Dam at some future time. Assuming drilling and blasting methods will be feasible, the Dam would be mined from the top down in a series of vertical lifts defined by the existing cold joints spaced about 5.5 to 6 feet apart.

Once a proven method is developed, multiple two-person crews of drillers could drill rows of boreholes defining multiple blocks of concrete. Vertical blastholes could be drilled with a track-mounted drill working on top of the dam or by hand-held sinking-hammer drills—like the ones used for shaft sinking work. Horizontal holes would likely be drilled with hand-held jackleg drills by workers standing on work decks suspended in place by a crane. If extensive large-scale horizontal drilling is needed, larger bar & arm drills could be mounted onto specially designed drilling platforms. If the concrete blocks must be jacketed, these crews could also perform this work. An on-site support crane could be used to suspend hanging work decks at locations where horizontal holes might need to be drilled to jacket blocks or for drilling blastholes to cleave the concrete apart at the cold joints.

These same workers, directed by licensed blasters, would then load holes drilled in three to four blocks and blast them simultaneously. Blasting may occur two to three times per day—depending on the time required for drilling and possibly jacketing the blocks.

Wire-rope cable slings would be attached to loosened blocks so they could be lifted off the Dam by the crane. Depending on how the blocks are broken, the slings might be attached by threading them through horizontal holes drilled through the bottom of the blocks or by jacking up the blocks so a skid plate with sling cables already attached can be slid below the blocks. Evaluating block-lifting methods will be an important feature of this demonstration project.

In order to make reasonably accurate projections of full-scale concrete quarrying costs, the time-study data for all test work should be collected and reported. The County might do this, or require the contractor to provide it as a pay item in the contract.

6.0 PROPOSED TEST BLASTS

As stated earlier, GEOTEK is designing all of the test blasts on the assumption that the concrete blocks will be significantly effected by existing cracks. Therefore, the testing scheme has been designed to evaluate how various quarrying methods will perform in the cracked concrete. For the 30-foot section of the Ogee concrete that will be available for the test blasting, GEOTEK recommends dividing it into six 5-foot-long test blocks. GEOTEK will propose specific methods for blasting the first three blocks. Results of these tests will be used to evaluate various drill-hole spacing, explosive loads and charge back-filling media. This information will then be used to direct the blasting for the remaining three blocks. The test-work contract documents should clearly specify that the VCFCD Engineer will direct the methods used for the final three tests. Using the time allotted for Task 7 of its current contract with VCFCD, GEOTEK will help direct the blast designs for the final three test blocks.

6.1 Test Blast Demonstration No. 1

At a distance of five feet from the open Ogee face on top of the Dam located approximately at Station 0+30, the contractor shall drill a row of vertical holes spaced on 8-inch centers. These holes, with diameter ranging from 1 ½ to 1 ¾-inches, shall be drilled 2 to 3 inches past the cold joint at the bottom of the Ogee. Where the Ogee protrudes out of the Dam on the downstream side, holes shall be drilled within 6 inches of the open bottom surface. No blastholes or portions of holes—except the hole-collars--shall be drilled closer than 4 inches to any open concrete surfaces.

The exposed upstream, downstream and top faces of the test block shall be jacketed with bolted wire mesh. Heavy wire mesh or metal fencing with openings on larger than 2 inches should be used to jacket the test block. The mesh shall be wrapped around the block and securing with 2-foot long mechanical rock bolts and 3/8-inch thick 3-inch square steel washer plates, underlain by 6-inch square wooden washers made of ½-inch plywood. At least 4 equidistantly spaced bolts shall be installed in the sides and top surfaces of the block (12 total bolts). Unless otherwise directed by the Engineer, all test blocks shall be jacketed in this manner. Bolts, mesh, and washers that are undamaged may be reused upon inspection by and approval of the Engineer.

Once the block is drilled and jacketed to the satisfaction of the Engineer, it shall be drilled, charged with 18-grain cord surrounded with B-Gel #2 and initiated as shown in Drawing TB1 shown in Attachment 1. Information about explosives and B-Gel—a pressure-buffering agent is given in Attachment II.

If the first blast does not separate and break the bond at the bottom of the block along the cold joint, the Contractor will be directed to drill holes spaced on 12-inch centers within the cold joint using horizontal holes. These holes will be loaded with 200-grain detonating cord. No annulus material will be placed around the cord and no Dynashear toe-charge will be used in these holes. At least one foot of the collars of these holes shall be plugged with clay or sand-filled stemming bags. These holes shall be drilled and charged from platforms attached to the Dam or from work platforms suspended from a crane. These charges would be initiated with an 18-Grain detonating cord trunkline and a detonator, similar to those used in the first blast.

6.2 Test Blast Demonstration No. 2

All aspects of the test procedure for the second block shall be similar to those used in the first test, except the spacing of the holes will be increased to 10 inches and the 18-grain detonating cord load will be replaced with 25-grain cord.

Once the block is drilled and jacketed to the satisfaction of the Engineer, it shall be drilled, charged and initiated as shown in Drawing TB2 shown in Attachment 1.

Again, if this blast does not break the block at the cold joint, the Engineer will direct the Contractor to drill and blast the plane of the cold joint with horizontal holes. The spacing of holes and charge loads may vary depending on results of prior test blasts. However, hole diameters and explosive products will be similar.

6.3 Test Blast Demonstration No. 3

In the third test the spacing of the holes will be increased to 12 inches and the 25-grain detonating cord load will be replaced with 200-grain cord. The B-Gel #2 annulus fill material will also be replaced with clean dry sand.

Again, once the block is drilled and jacketed to the satisfaction of the Engineer, it shall be drilled, charged and initiated as shown in Drawing TB3 shown in Attachment 1.

Procedures similar to those described for tests 1 and 2 will be used to shear the block at the cold joint if needed.

6.4 Test Blast Demonstrations Nos. 4 Through 6

Based on results of the first three tests, the Engineer, the Contractor and the Engineer's Consultant shall mutually review all prior results and design a blast procedure for block No. 4. Assuming the tests are producing encouraging results, this process will be repeated for block Nos. 5 and 6.

6.5 Required Explosive Products

The exact quantities of explosives, B-Gel #2 and other blasting accessories that will be used for these tests is not known. However, for bidding purposes, the Contractor should be prepared to use the following minimum quantities of the products listed below.

Product	Package or Cartridge Size	Quantity	Units
B-GEL #2	50-lb Bags	100	lb
Dynashear (or equivalent)	¾ x 6-inch (45-lb/case)	225	lb
200-Grain Cord		1,500	ft
25-Grain Cord		1,000	ft
18-Grain Cord		2,000	ft
Clay or Sand Stemming bags		200	Units

7.0 RECOMMENDATIONS FOR STRUCTURING THE WORK CONTRACT

GEOTEK has estimated that the total cost of the blasting demonstration work will be around $100,000. An itemized summary of the costs, overhead and profit used to generate this estimate are given in Attachment V. This cost is very high despite the very small amount of blasting that will be done. In order to support the drilling and block jacketing work, it has been assumed that a small work crane will need to be on site to suspend a work deck. Although the work may occur in less than two weeks, it has been assumed that the minimal rental/lease periods for equipment will be one month. Moreover, a 5-person crew has been used to ensure that all the work can be done safely. The cost summary was done in EXCEL and the file is saved on the enclosed CD-ROM, along with the report and drawing files.

The cost of the blasting portion of the demonstration tests might be reduced by as much as 20% if a single Prime contractor with blasting skills does all the tests—sawing, mechanical and blasting. If this happens, there will be less duplication of support equipment and labor. Preparation and setup time will also be reduced.

Because this work is designed to carefully measure and evaluate results, it will occur at a much slower rate than that of full-scale production work. Once proven methods are developed, the work will be much more efficient and the cost per block of quarried concrete will be substantially lower than that of the test work.

For biding purposes, it would be wise to request prospective bidders to submit their bids with fully itemized labor, material and equipment rates. Mobilization and demobilization costs should also be separate. Due to the unforeseen nature of this test work, it is very possible that VCFCD will be negotiating work changes with the contractor. Having itemized cost figures will aid VCFCD's position for negotiating changes.

8.0 SUMMARY

GEOTEK hopes this analysis is helpful. It has been very difficult to define too much detail in this test program because of the uncertainty of how the concrete will respond to blasting. It is encouraging that block-quarrying methods have been successfully used in the past to section and remove concrete. Hopefully, it will also be successful and economically feasible for deconstructing the Matilija Dam.

In order to develop good information for evaluating the full-scale costs of the tested methods, it will be important to carefully track the time required for drilling, loading and all other key components of the work. Perhaps the County might consider assigning an engineer or engineering co-op student to this project to carefully document results and keep time-study records. All work and results should be photographed with time/date stamped photos.

If needed, GEOTEK will be pleased to help VCFCD develop a form for recording key work-time and results data.

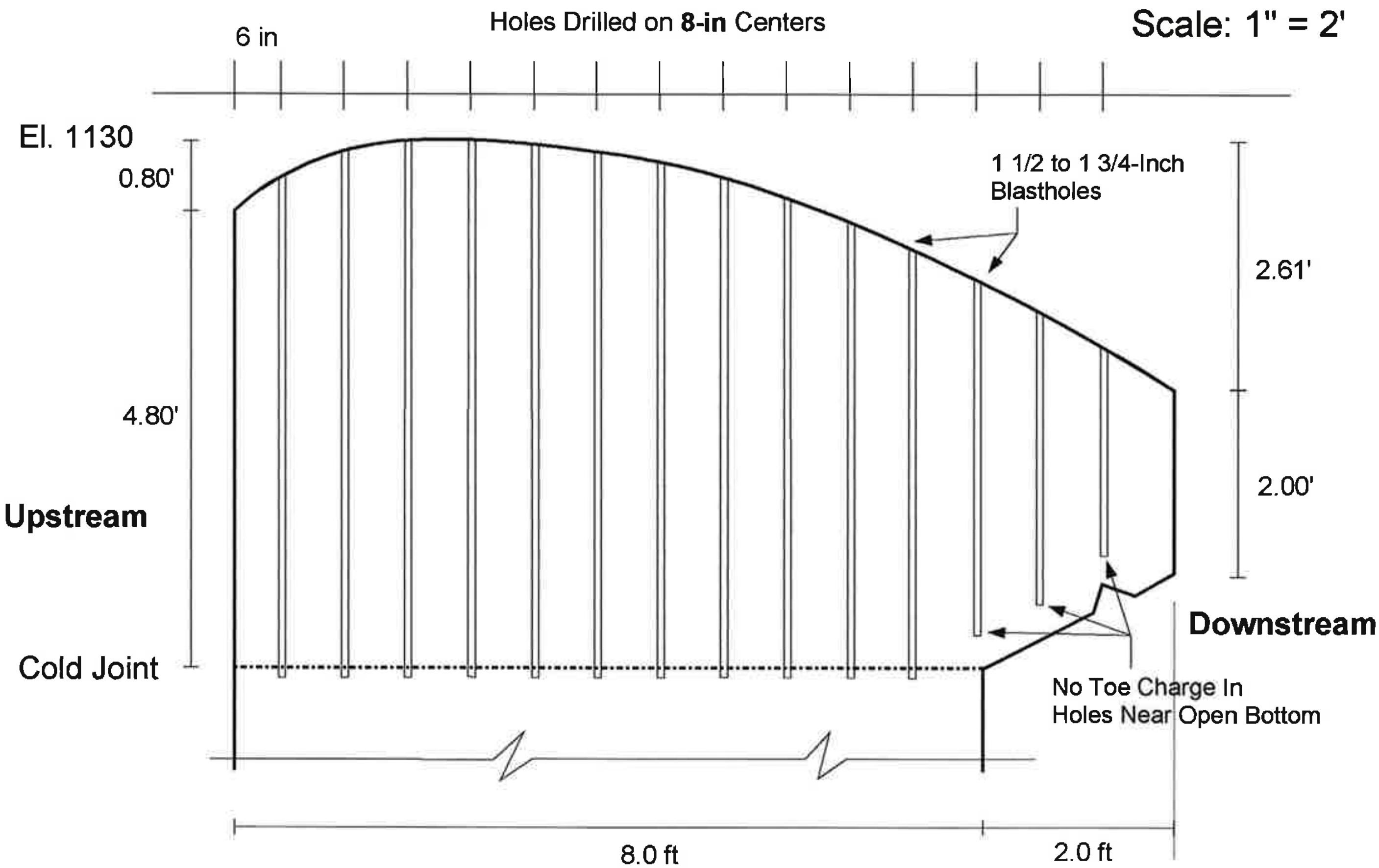
Respectfully submitted,

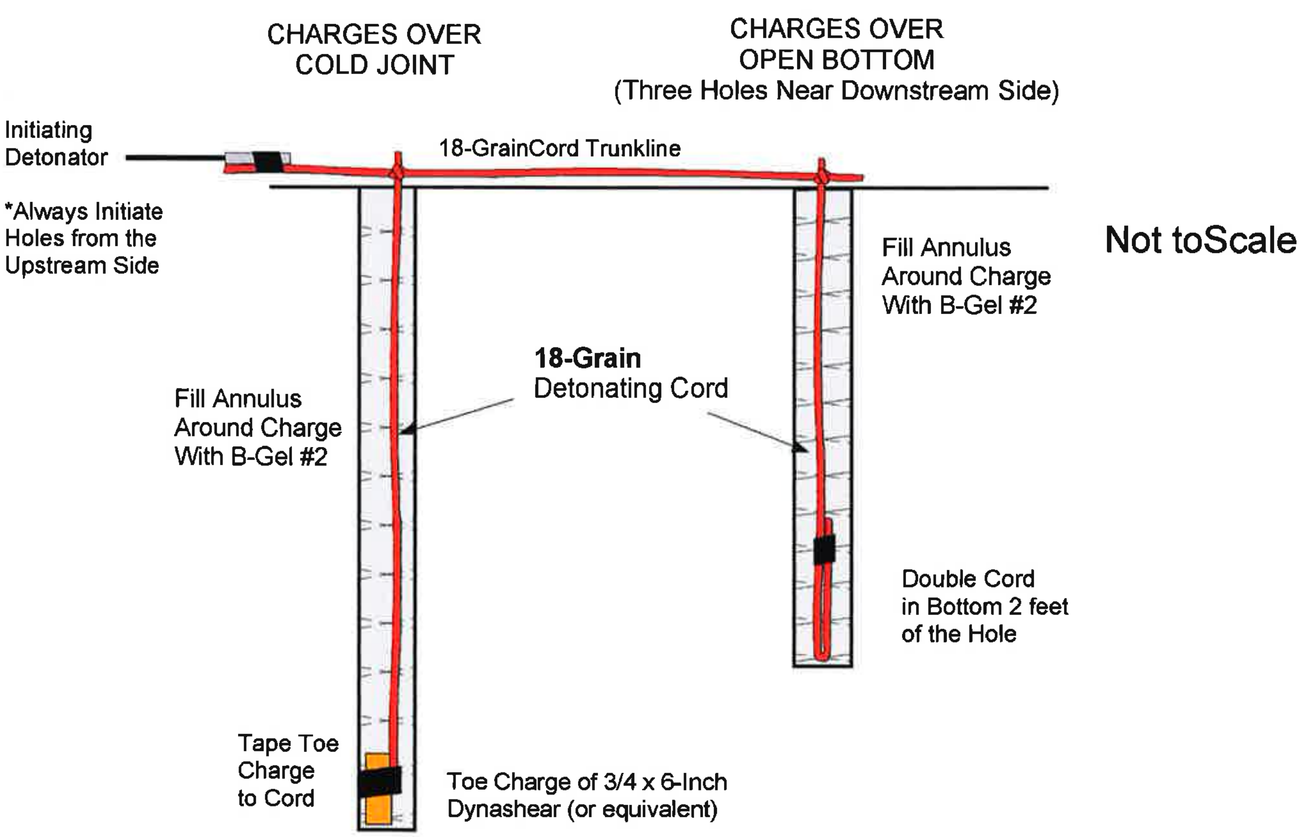
Gordon F. Revey

ATTACHMENT I

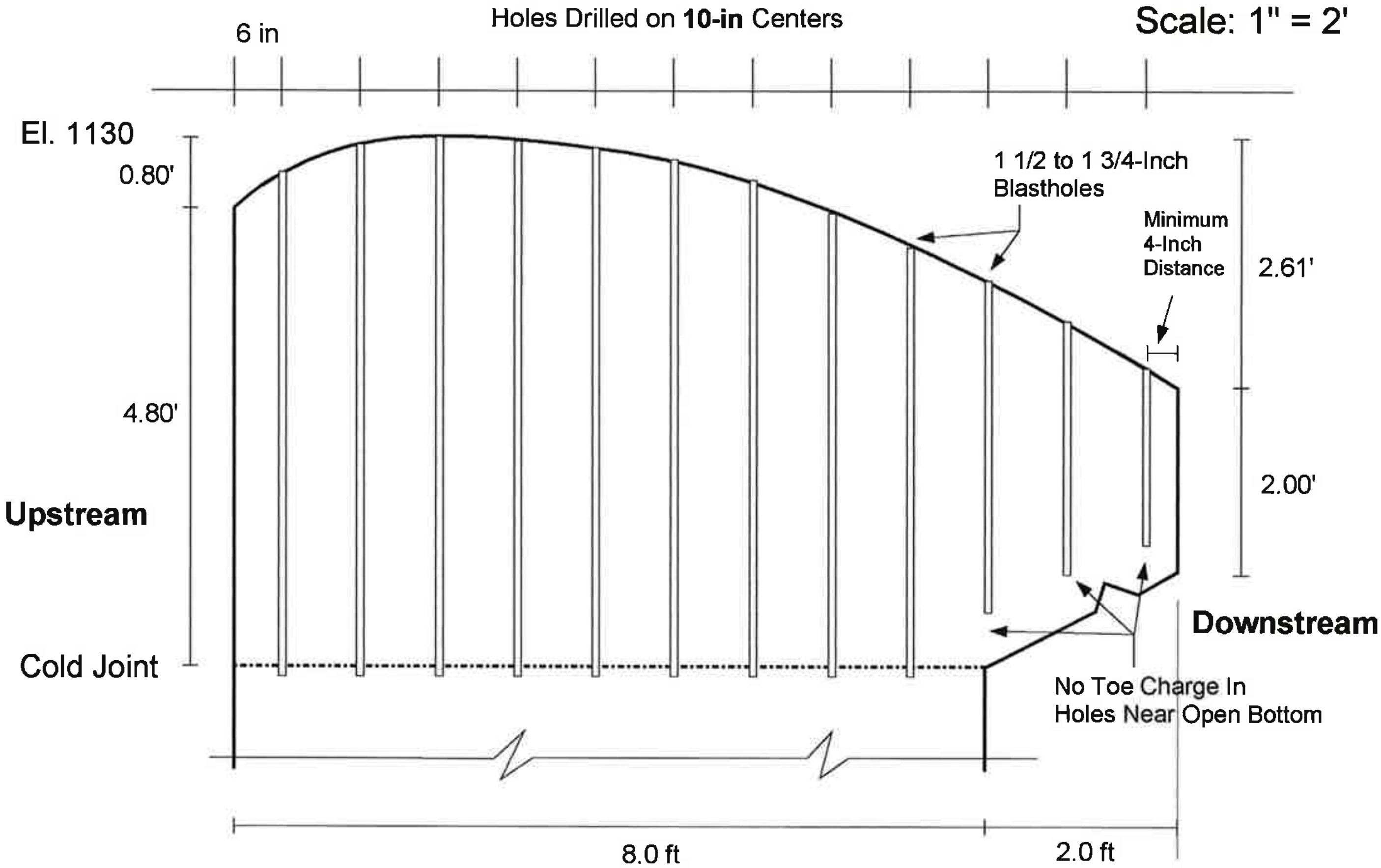
BLAST TEST DEMONSTRATION DESIGN DRAWINGS

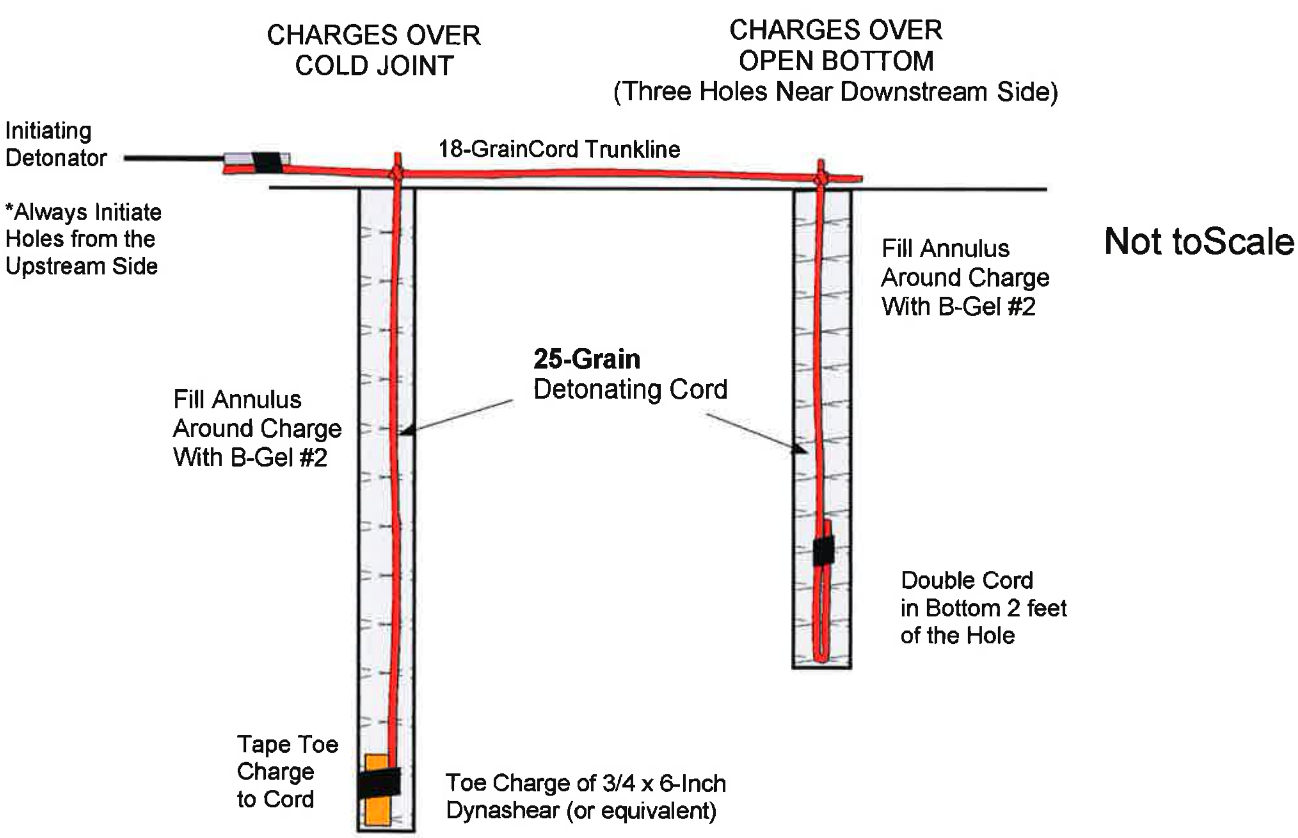
DRAWING TB1--TEST BLOCK No. 1 DRILLING & BLASTING PLAN



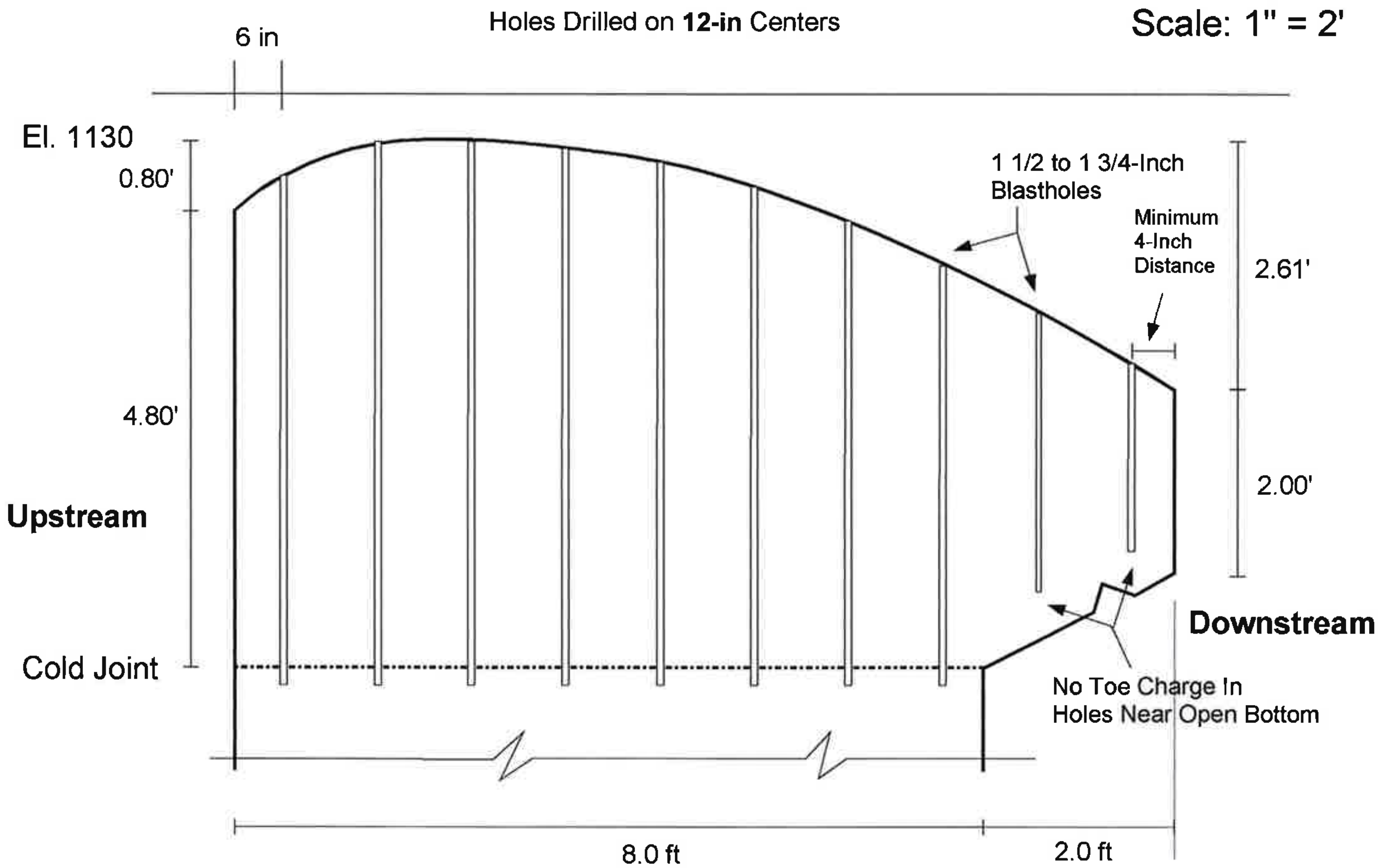


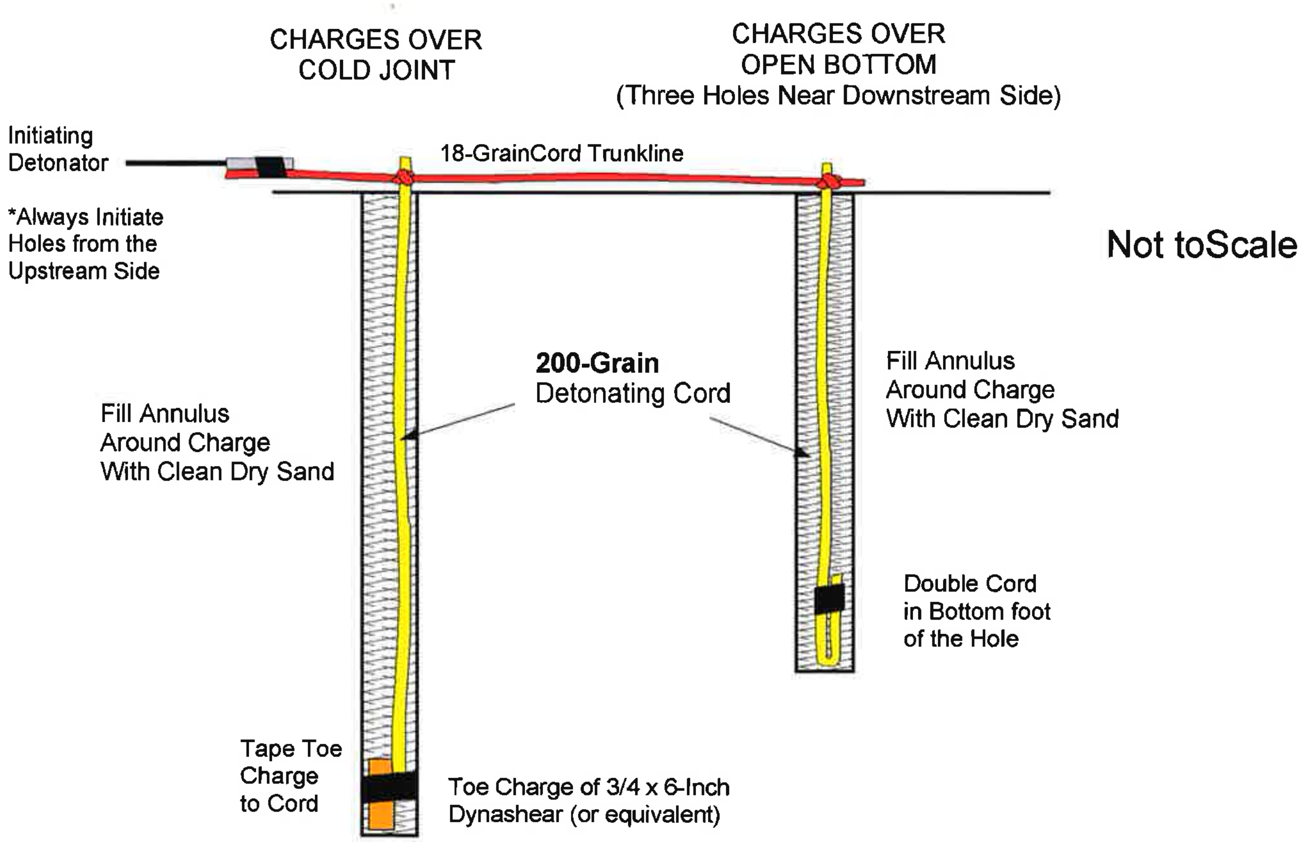
DRAWING TB2--TEST BLOCK No. 2 DRILLING & BLASTING PLAN





DRAWING TB3--TEST BLOCK No. 3 DRILLING & BLASTING PLAN





ATTACHMENT II

EXPLOSIVE PRODUCTS AND B-GEL DATA

Data Sheet No. 101

DYNASHEAR™

Ammonia Dynamite

Use

- quarrying of dimensional stone

Benefits

- less hazardous to use than black powder
- high gas volume - low detonation velocity
- minimize hairline cracking
- economical

Priming

To initiate, use a high strength detonator or CORDTEX® 18 or higher coreload detonating cord.

DYNASHEAR

Properties

DYNASHEAR	
Cartridge Density (g/cc)	0.75
Velocity of Detonation (ft/s)* $^{7}/_{8}$"	5,500
Water Resistance	Poor
Relative Weight Strength (RWS)**	46
Relative Bulk Strength (RBS)**	41
Fume Class	3

* unconfined at 41°F

** All ICI Explosives energy values are calculated using IDeX™, the computer code developed by ICI Explosives for the exclusive use of its companies. Other computer codes may give different values.

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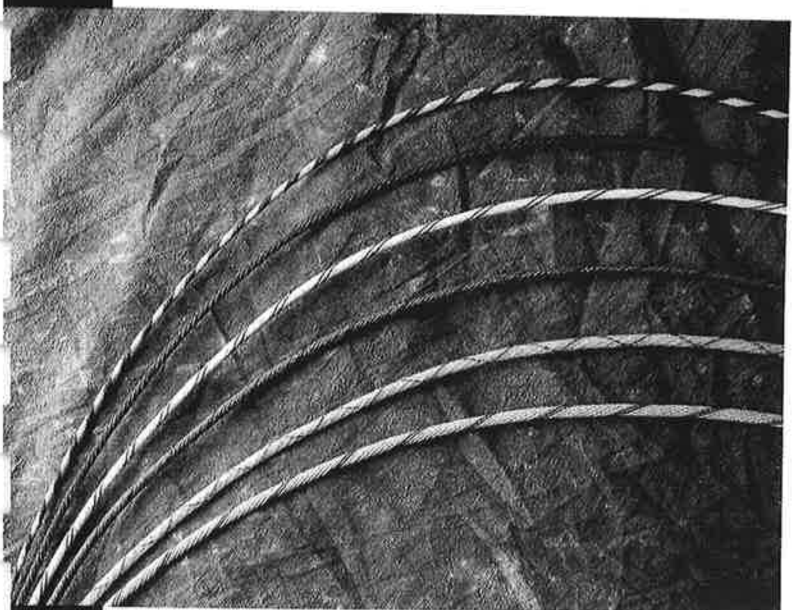
Explosives

Data Sheet No. 702

CORDTEX®

Detonating Cord



Features

CORDTEX detonating cords are manufactured with an explosive core of PETN, encased in textile yarns and a plastic jacket with a yarn/wax finish. The wax color and identifying thread code of the final finish provide easy identification of each grade.

Use

There is a grade of CORDTEX detonating cord that will satisfy all blasting requirements for both surface and underground applications.

Benefits

- rugged, abrasion-resistant finish
- good knot tying characteristics
- excellent resistance to side penetration of oil and water
- high tensile strength
- available in a variety of coreloads to meet job requirements

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Explosives

CORDTEX

CORDTEX
Detonating Cord

Product Type	Nominal coreload g/m	gr/ft	Nominal diameter mm	in	Breakload kg	lbs	Wax Color	Identifying Thread Code	Packaging
CORDTEX 7.5	2.0	9.5	3.2	0.127	90	198	yellow	5 parallel black	two 300 m, 984 ft. spools/case
CORDTEX 15	3.2	15	3.7	0.146	75	165	red	1 black 1 white	two 500 m, 1,640 ft. spools/case
CORDTEX 18	4.9	23	4.2	0.165	100	220	green	2 parallel black	four 300 m, 984 ft. spools/case
CORDTEX 25	5.3	25	4.2	0.165	100	220	red	1 black	four 300 m, 984 ft. spools/case
CORDTEX 40	7.5	35	4.7	0.185	100	220	yellow	2 crossed black	two 300 m, 984 ft. spools/case
CORDTEX 50	10.2	48	5.1	0.200	110	242	yellow	2 parallel black	two 300 m, 984 ft. spools/case

Recommendations

CORDTEX may be cut using a sharp knife or an anvil-type pruning shear.

All CORDTEX detonating cords may be initiated by CORDTEX 18 or any higher coreload detonating cord by a high strength detonator.

Warning: CORDTEX 7.5 and 15 are reduced coreload detonating cords and should not be spliced (knotted) together or used to initiate other detonating cords. Misfires will result.

Storage

For best results, store at moderate temperatures and dry conditions in a well ventilated, approved explosives magazine.

Transportation

UN Classification:
CORDTEX is Cord, Detonating, 1.1D, UN 0065.

ICI Explosives

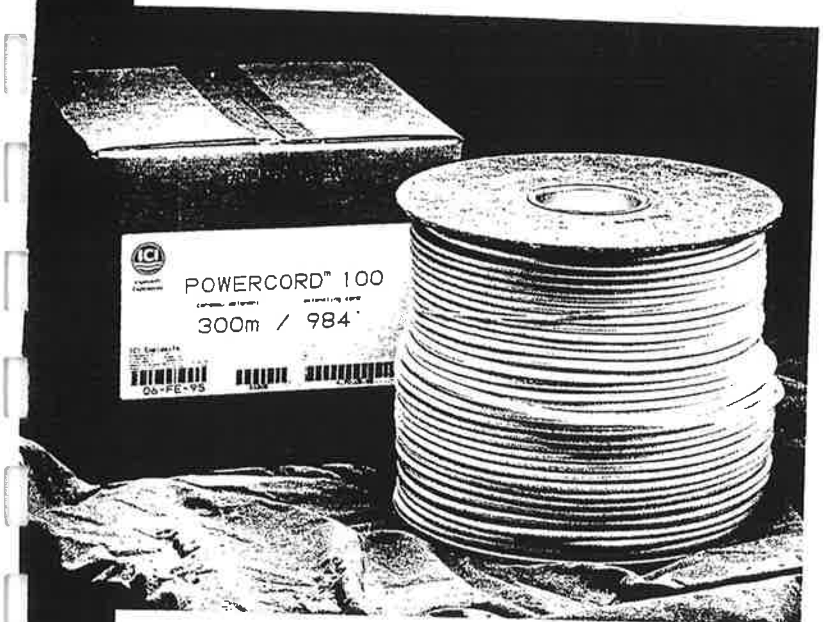
ICI Explosives USA Inc.
15301 Dallas Parkway, #1200
Dallas, Texas 75248-4629
(214) 387-2400

3M/9-93

Printed in the U.S.A.

POWERCORD®

Detonating Cord



atures

POWERCORD is manufactured with an explosive core of PETN, enclosed in textile yarns with a clear plastic finish.

Product Type	Nominal Coreload g/m	Nominal Coreload gr/ft	Nominal Diameter mm	Nominal Diameter in	Breakload kg	Breakload lbs
POWERCORD 60	12.8	60	4.8	0.190	80	176
POWERCORD 100	22.3	105	6.1	0.240	100	220
POWERCORD 150	31.9	150	7.0	0.275	120	264
POWERCORD 200	42.6	200	7.6	0.300	120	264

- perimeter control blasting for surface and underground applications
- dimension stone splitting

- easy to use
- uniform linear charge provides even energy distribution
- rugged, abrasion-resistant finish
- excellent resistance to side penetration of oil and water
- variety of coreloads to meet specific job requirements
- high shock energy produces a clean split

ALWAYS

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Explosives

POWERCORD

Detonating Cord

ecommendations

POWERCORD may be cut using a sharp knife or anvil-type pruning shear.

POWERCORD may be initiated with B-LINE, CORDTEX 25 or any higher coreload detonating cord, or with a high strength detonator.

ackaging

Product Type	1 Spool/Case m	ft
POWERCORD 60	300	984
POWERCORD 100	300	984
POWERCORD 120	150	492
POWERCORD 200	150	492

Storage

For best results, store at moderate temperatures and dry conditions in a well ventilated, approved explosives magazine.

Hazardous Materials Shipping Description

Cord, Detonating, Class & Division 1.1D, UN0065, PG II.

Explosives

ICI Explosives USA Inc.
15301 Dallas Parkway, #1200
Dallas, Texas 75248-4629
(214) 387-2400

3.5M/3-95

Printed in the U.S.A.

B-Gel General Information

INTRODUCTION -

Viking Explosives & Supply was founded in Minnesota in 1968. Viking is a member of the Sasol DHB group of companies, which produce and distribute explosives, blasting accessories, ammonium nitrate, industrial chemicals, and fertilizers. Viking has a long history of bringing the best available technolgy to it's customers. The acquisition of the B-Gel technology in 1999 is another step in this direction.

PURPOSE OF B-GEL -

Reduce the cost and increase the profits in dimension stone quarrying.

WHAT IT IS -

With traditional blasting in dimension stone, detonation of the explosive causes shock cracks and spider cracks, both of which reduce the yield of usable stone. B-Gel is sold as a premix which is blended with water at the quarry to produce liquid B-Gel. This shock-absorbing liquid is used in the holes to cushion the shock of the detonation, while still transferring all of the power, giving effective splitting with very little other cracking.

HOW IT'S USED -

Holes are drilled into the rock both vertically and horizontally, the spacing between them depending upon the stone. Detonating cord of suitable strength is then inserted. Liquid B-Gel is pumped or poured into the holes. Detonation of the cord separates the loaf or splits the block via smooth, even fractures.

BENEFITS -

- Non-explosive, non-combustible, non-corrosive, and stable; requires no special storage
- B-Gel premix blends easily with water on site
- Formulation is adjustable for stone type and block size
- Pours easily into vertical holes; stays in horizontal holes after pumping
- Virtually eliminates spider cracks and shot cracks
- Saves significant time in trimming blocks
- Eliminates wedging
- Reduces block material loss by 40% or more
- Reduces costs per net yield in the quarry and in the plant.

PATENTS -

The formulations for and the use of B-Gel are covered by US Patents 5,810,098 & 5,900,578. Patents are pending in other countries. Viking Explosives & Supply, Inc. has the exclusive, world-wide rights to this technology. The right to use B-Gel as a shock absorber in blasting is conferred by the purchase of the product from Viking or from one of its appointed distributors for B-Gel.

Viking EXPLOSIVES & SUPPLY, Inc.

12955 Courthouse Blvd
Rosemount, MN 55068
Tel 651 437 3101 Fax 651 437 4136

Inquiries

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Tel 218 263 8845 Fax 218 262 4574

Dramatic increase in net yield of dimension stone using revolutionary shock absorber.
Viking Explosives & Supply now offers patented B-Gel product
- Cold Spring Granite Company - Milbank Quarry, SD -

B-Gel being loaded into pre-drilled blocks, and the results

Cold Spring Granite Company is the largest granite quarrier and fabricator in North America. Over 100 years ago Cold Spring began a tradition of being on the cutting edge of technology, to make the quarrying and fabrication of granite safer and more cost effective. The latest break-through for this company is a product called "B-Gel" that is revolutionizing the dimension stone industry.

Using traditional quarrying methods to shoot a line of drill holes, the detonating explosive creates a shock wave, causing shot cracks, or spider cracks, that are driven into the loaf. It is certainly not uncommon to find cracks driven one foot deep, sometimes more. Shot cracks dramatically decrease the amount of usable stone at a quarry, thus decreasing the net yield. In addition, conventional blasting methods would sometimes cause a "blackening" of the stone, or leave a smoke stain on the granite. This increases the amount of scrap stone, and also adds to equipment and labor costs. With B-Gel, there is no blackening of the stone. Sometimes there is a milky film present after blasting, but this can be easily cleaned off with a pressure hose and water.

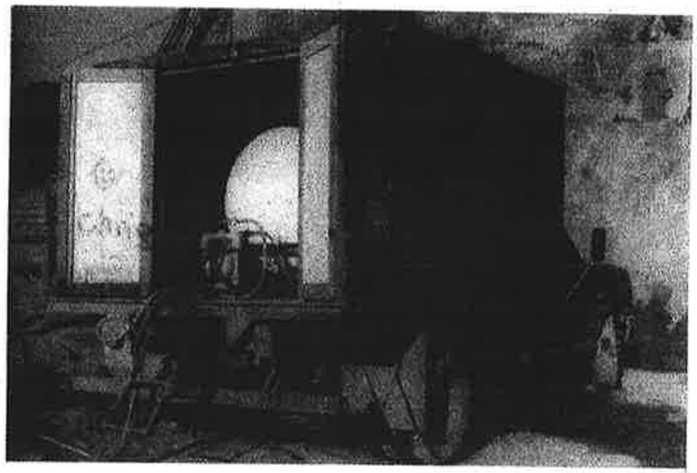
Leon Eisenschenk, General Manager of the Milbank, South Dakota quarry, wanted to find a product that would help reduce or eliminate shot cracks, and increase the yield of usable stone, while maintaining their high safety standards. "We tried anything and everything," explained Mr. Eisenschenk, "and that included almost every explosive and method known." Up to that point, their most successful method was using a 7 grain detonating cord and water.

B-Gel has revolutionized the way Milbank quarries its stone. Using a combination of 18 grain cord and B-Gel, the quarry has doubled it's over-all net yield (going from 10% to 20%) in the last 2 years. B-gel's versatility and shock absorbing qualities make it [according to Leon Eisenschenk] at least 50% responsible for this dramatic increase. In addition, in the finishing plant, B-Gel has taken the 52% to 55% net recovery up to approximately 65%, primarily due to the elimination of shot cracks.

B-Gel is used as a liquid that is poured or pumped into drill holes after they have been charged with detonating cord. The liquid is easily prepared by dispersing B-Gel powders or premix in water. From the testing of the product at Cold Spring Granite's Milbank quarry, it was discovered that B-Gel can be adjusted to change it's shock absorbing capacity for each quarry and stone type. At it's optimum formulation, the liquid gel will absorb enough of the shock energy to prevent driving shot cracks, but still split the stone. Mr. Eisenschenk says that

Using B-Gel and detonating cord, much thinner slabs can be trimmed from a block than is possible by wedging. The natural shock absorbing properties of the gel leave corners square and undamaged.

they "got things started right, and that's the key. Some companies mix a little by hand, but we got a mixing tank and pumping gear right away, and it's running smoothly."
Currently, Cold Spring Granite Company uses a mixing tank that produces 520 gallons of the B-Gel liquid per batch. This mixture will last about a day at Cold Spring's production rate. After the gel is mixed, it is delivered to the site using a bulk loading truck, and pumped into pre-drilled holes.

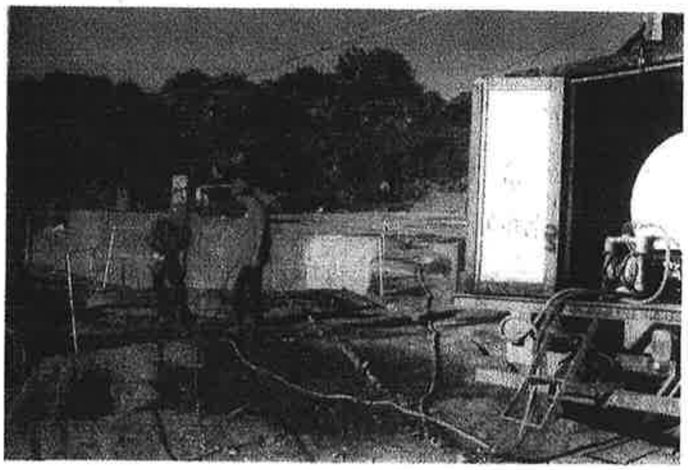


Cold Spring Granite's bulk delivery truck for B-Gel.

Along with virtually eliminating spider webbing and shot cracks, and increasing net yield, B-Gel produces other benefits. It prevents smoke stains on the granite that result from the blasting process. Another benefit is the control of fly rock. This is one of the key issues when it comes to personal safety. According to Leon, when a loaf is shot, there is very little downtime. He doesn't have to move vehicles out of the area to prevent breaking windshields, denting hoods, or any number of other fly rock related damage.

Using B-Gel in the blasting process has increased efficency. B-Gel takes about the same amount of time to load as would a cord and water combination. It is a much faster process than dry shooting with stick powder and detonating cord.

Holes are drilled into the rock, both vertically and horizontally. The distance between the holes depends on the particular type of rock being mined. Cold Spring uses the B-Gel mixture with a 1.25 inch diameter hole and 5.5 inch hole spacing when shooting a line or trimming



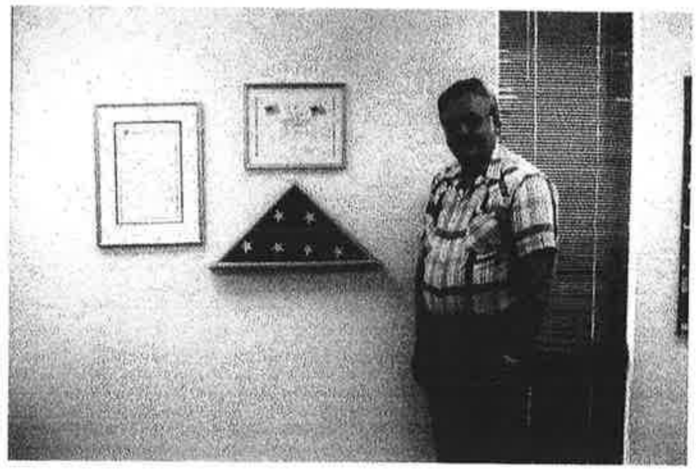
Bulk loading of B-Gel into a pre-drilled line of holes.

blocks. If the hole diameter, the hole spacing, or even the strength of the detonating cord were changed, it would just be a matter of adjusting the B-Gel mixture to get the desired results.

Much of the development of B-Gel was accomplished at the Cold Spring Granite Company, testing stone of different properties, various block sizes, etc. A formula was optimized for the Milbank quarry, and other improvements have been implemented at the quarry. General Manager Leon Eisenschenk said,

100 foot pre-drill line shot with 18 grain cord and B-Gel.

"That Gel has been a God send to us. It means more product hauled out, a lot less work, and has been at least 50% responsible for the net increase here at the quarry."



Leon Eisenschenk, General Manager of the Milbank, SD quarry. The flag in the picture was flown over the Capitol in celebration of the opening of the FDR memorial. All the stone used in the memorial was supplied by the Milbank quarry.

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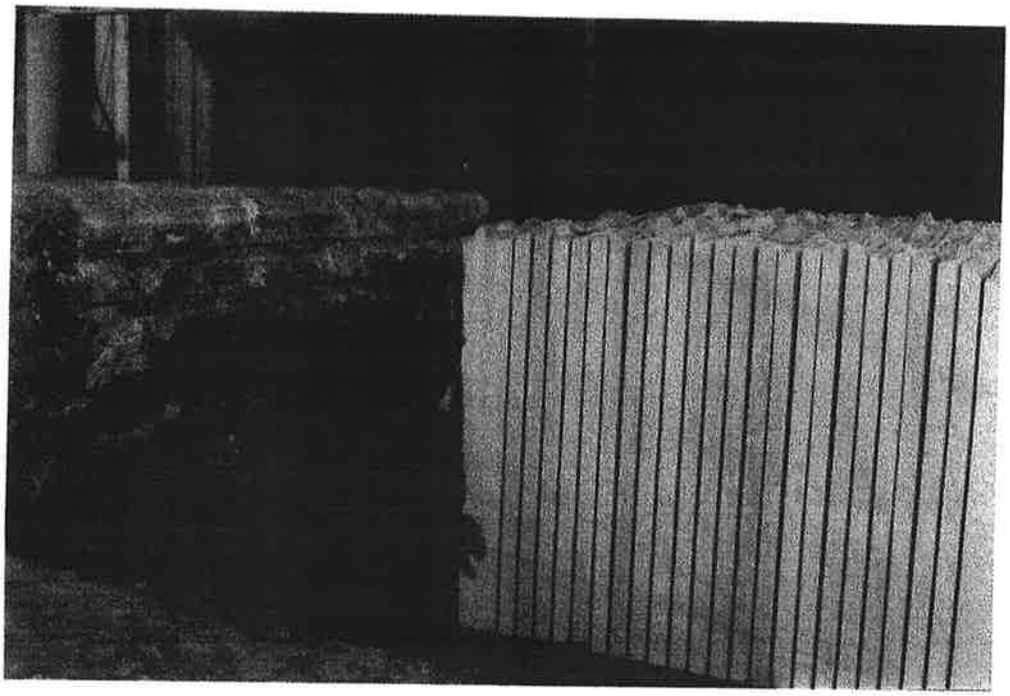
Tulsa Stone - Tulsa, Oklahoma

New Advances from Viking Explosives & Supply, Inc.
Bold claim for the limestone industry:
"We produce better results with lower cost!"



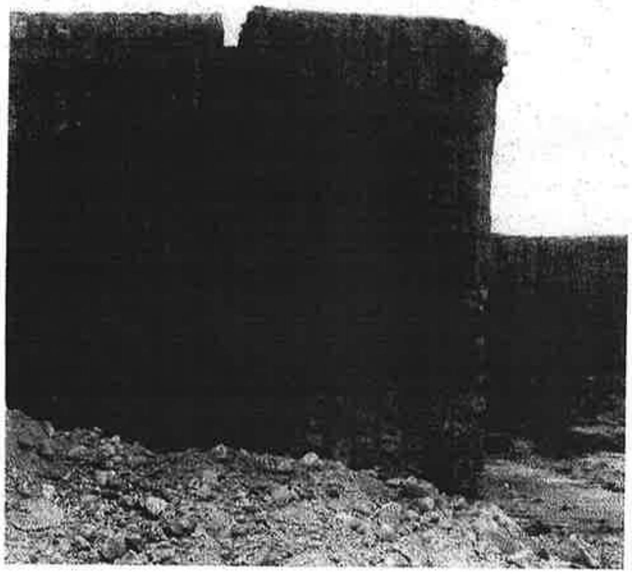
Blocks quarried using B-Gel means an increased net yield at the plant.
This picture shows blocks before and after the cutting saw.

Limestone can be a challenging rock from which to produce dimension stone. It is formed from accumulations of marine plants and animals that have died, settled to the bed of a sea, become compacted, and over centuries, have cemented together. For this reason, limestone deposits often contain beds of other material.

Some of the limestone found in the quarry at Tulsa Stone has mud and shale seams that make quarrying the stone difficult in places and almost impossible in others. After experimenting with various combinations of explosives, cord, hole spacing, and hole diameter, the most successful conventional combination the quarry could find was using 100 grain detonating cord in 2.5 inch diameter holes. Results with this method were improved by loading sand into the holes to surround the cord, but even this combination had it's share of problems. It was not uncommon for the blocks taken from the quarry to have blasting fractures or secondary fractures. This would significantly decrease the amount of salvageable stone for the plant. Also, the amount of explosives needed to remove blocks from the bench would often push the stone that had been shot too far forward, causing it to topple into the pit, even when 70 grain cord was used. This would cause even more damage to the stone. On the other hand, using 40 or 50 grain cord with sand wouldn't move the stone at all.

New product has bold claim...

A new shock absorbing product, B-Gel, was introduced with the claim that it would decrease shot cracks, improve net yield, and lower costs when used with 40 grain cord. General Manager Matt Parker was impressed by this claim and opened the Tulsa Stone quarry for a demonstration. The testing showed Tulsa Stone that B-Gel (a creamy, non-explosive liquid) was more than capable of meeting the claim. After the first line was shot with B-Gel, the block remained standing, which was something that previous blasting methods were unable to do. In the past the bottom 2 to 3 feet of the stone was shattered by the shot, causing the block to fall over. B-Gel was able to save the bottom of the block, so that the whole block could be hauled to the plant, which nearly doubled the yield of blocks taken from this area of the quarry. In addition, the bottom of these blocks is a high quality "tuxedo gray" limestone which can take a polish, and has the potential to open up new markets for Tulsa Stone products.



Blasting with B-Gel and 40 grain cord leaves the edges and corners of the blocks intact, as shown on the right.

Eliminate fractures and cracks at the blasting stage.

By using B-Gel with 40 grain cord, secondary fractures and blasting fractures have been virtually eliminated. Any fracturing now is due to mud or shale seams already in the stone. Head blaster Bob Montgomery said, "We are able to salvage more rock, even from a [poor quality] ledge, than we ever were able to with sand." With B-Gel, they are able to consistently remove 6 to 8 good blocks out of 9, something they were unable to do with previous shooting practices.

Easy to use, and very safe!

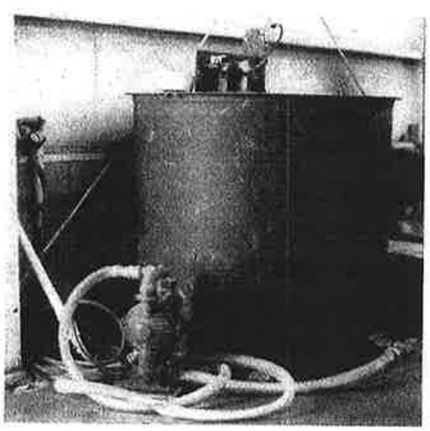
Limestone blocks are removed from the bench two at a time. All the blocks in a bench are pre-drilled, but only the holes around the two blocks that are to be removed are loaded for shooting. Each block is approximately 7' x 4' x 13' high, and is outlined by 2.5 inch diameter vertical holes drilled on an 8 inch spacing. The holes are loaded with 40 grain detonating cord, and then B-Gel is pumped around the cord to fill the holes. The remaining holes in the bench are capped to prevent water or foreign objects from getting into them. When the cord is detonated, B-Gel absorbs some of the initial shock, but still transfers enough of the explosive force to separate the block from the bench. The blast isn't even damaging to the pre-drilled lines of the adjacent blocks.

Loading B-Gel into the holes after the detonating cord is simple and easy

Being able to contain and focus the force of the blast in this way is one of the major benefits to using B-Gel. Also, the ability to tailor B-Gel's shock absorbing properties makes it extremely versatile for improving block quality in all types of rock. Matt Parker was very impressed by the demonstration and decided to make the switch from 100 grain cord and sand to 40 grain cord and B-Gel. The gel is quicker and easier to load than the sand and cord combination. In addition, the blasting cost per block didn't increase. On the contrary, because of the improvement in block quality when using B-Gel, the blasting cost per cubic foot of recovered stone actually decreased.

Getting started the right way

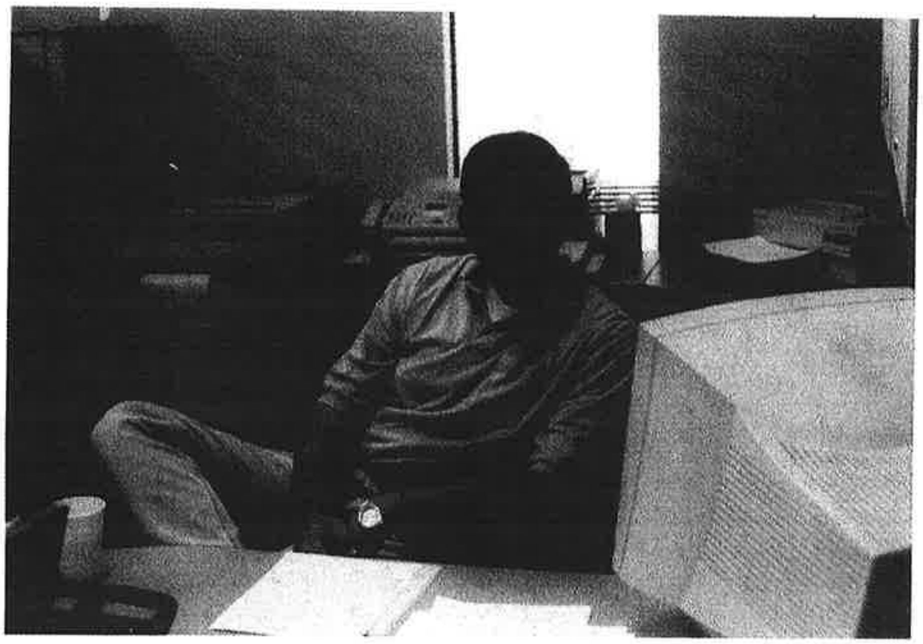
When Tulsa Stone made the decision to use B-Gel, they installed a mixing tank and built a bulk loading system. The bulk loading equipment (tanks, hose reels and diaphragm pumps) is mounted on a trailer, which enables it to be moved easily between the mixing tank and the blasting sites. This system greatly simplified the mixing and loading of the gel. The quarry currently produces B-Gel in batches of about 720 gallons, which lasts about 2 days. The bulk system allows both the preparation and the loading of the gel to be done by a single operator.



B-Gel mix tank and bulk delivery trailer

Getting something from nothing

B-Gel's revolutionary shock absorbing qualities have made it a key item in the quarry. Matt Parker said, "We used B-Gel to cut down on our waste. I've been impressed by it so far." The section of the quarry from which Tulsa Stone is currently removing blocks contains a lot of mud and shale seams. This made it very difficult to produce good quality blocks. The yield from this section of the quarry is not as good as from other areas, but B-Gel is even able to improve the yield from this area. Blast Foreman Bob Montgomery finished by saying: "The area we're shooting now, we wouldn't have gotten anything out without B-Gel. The method works....."



General Manager Matt Parker
"I switched to B-Gel to cut my waste. Simple as that.
I've been impressed with it."

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ATTACHMENT III

CONCRETE SECTIONING CASE HISTORY PAPER BY D. H. MATTHEWS

1978 – NEW ORLEANS

THE USE OF DETONATING CORD TO SECTION CONCRETE STRUCTURES INTO REMOVABLE SIZE BLOCKS

Donald H. Matthews, President of Explosives Engineers, Inc.
Sparks, Maryland

ABSTRACT

The usual method of dismantling massive concrete formations with explosives, is to totally demolish the entire concrete structure. If any portion of a concrete structure is required to remain in its original form and retain its structural integrity, the use of explosives is usually forbidden and the portion to be dismantled is demolished by mechanical means, using various techniques and equipment that are tedious and expensive.

Sawing, cutting with flammable systems, or drilling and wedging concrete, all may be used to section concrete under certain conditions, but may not be applicable in every situation. All demolition systems that fracture concrete rely on concentrated energy force being applied until the force exceeds the strength of the concrete and it is caused to fail and separate into smaller pieces. This principle has limitations because the shock wave precipitated by the application of force to the concrete is not always limited to only that immediate area of introduction. The most efficient concrete demolition system must include a force great enough to exceed the strength of concrete but be manageable so that any energy transmitted beyond a given area will be limited to inconsequential levels.

This paper describes an ideal way to dismantle a massive concrete structure by sectioning the concrete into removable size pieces of concrete, by the use of explosives.

TEXT

In February, 1977, piers 21 and 22 of the James River Bridge at Jordan Point near Hopewell, Virginia, were severely damaged by a ship colliding with the bridge. The lift span and the adjoining east approach span were dislodged into the water, making the bridge inoperable and requiring extensive repairs and forcing long detours I of heavy traffic.

The James River Bridge was approximately 10 years old. Pier 21 was constructed with underwater piles supporting a concrete tremie seal base under a formed concrete footing 69 feet long by 33 feet wide and 11 feet thick. Number 11 size steel reinforcing rods extended from the footing up into the two columns and into the strut wall that was approximately 23 feet long by 15 feet wide by 6 feet high and constructed monolithically with the two vertical columns. The columns contained the same size number 11 reinforcing steel and all vertical reinforcing steel was tied in with horizontal steel and boxed in with additional steel rods. All reinforcing steel was placed to form mats that were encased approximately four to six inches when the concrete was poured. Each of the two columns was approximately 15 feet by 10 feet square at a point level with the top of the joining strut wall, and extended approximately 55 feet above the footing, or about 35 feet above water. A heavily reinforced concrete cap, 41 feet by 12 feet wide by 11 feet high' topped off the two columns. The pier, with both columns and its cap, was still intact from the crash but divers had ascertained major structural damage had occured underwater.

Pier 22 was constructed similar to pier 21 but was of smaller dimensions and above water observation showed pier 22 with only a portion of one column remaining in place, with the cap missing and the other column broken off below water. Underwater inspection proved the missing column to be totally severed at approximately the top of the strut wall and major damage to the remaining column that still showed above water. The total extent of damage to both piers, footings, tremie, and piles, could not be determined without dewatering the structures for visual inspection, but it was obvious that major demolition and reconstruction was necessary. However, it was determined that the bridge must be returned to service as rapidly as possible and that total demolition of the two piers, footings, and tremie bases prior to reconstruction, would entail too much delay. Therefore, it was decided to demolish and reconstruct only those portions of the two piers that was absolutely necessary and to make the decisions as to which concrete must be replaced only after visual inspection could be made in the dry.

In June 1977, McLean Contracting Company of Baltimore, Maryland, contracted to remove the damaged concrete columns and strut walls of piers 21 and 22 to the top of each footing and to reconstruct both piers to the top of the columns, with the concrete caps to be constructed by others. The contract also specified the footings of the piers would be replaced in part or completely, depending on the extent of existing damage. The work was to be completed by September 15, 1977, with a $1500.00 per day penalty, and because of the urgency of the project, explosives could be used.

Explosives Engineers, Inc. contracted to perform all drilling and blasting work necessary to enable McLean to remove the concrete for reconstruction of the two piers. Explosives Engineers, Inc. offered McLean the choice of two different methods of demolition. The conventional system of using explosives to thoroughly fracture the massive concrete into smaller pieces involved less financial risk but would require more time for excavation. The other method involved the use of explosives to sever the concrete structures into blocks up to 150 tons in size so that McLean could remove and dispose of individual blocks of concrete instead of mucking out fractured concrete mixed with twisted reinforcing steel. This method was untried and unproven but, if completed successfully, promised great savings in time, equipment, and money. On June 6, 1977 Explosives Engineers, Inc. commenced drilling pier 21 to prepare it for sectioning into large blocks.

It was most critical that demolition of the structures not compound nor extend any damage to any part of the structures not previously damaged by the ship crash. To prevent transmittal of excessive vibration thru the vertical reinforcing rods to the footing and tremie base, Explosives Engineers, Inc. girdled each column at water level. A horizontal hole was drilled approximately eight inches behind each face, which placed it directly behind the vertical reinforcing rods, and each of the four holes in each column was charged with a single length of 400 grain Primacord, taped lengthwise on a piece of 1.25 inch diameter plastic pipe. Each hole was primed with a Hercules electric blasting cap and the full length of the columnar charge was aligned so the Primacord contacted the sidewall of the borehole closest to the face of the column. Approximately 18 inches of each hole was stemmed with sand filled paper tamping bags and rubber tire blasting mats were suspended around each column at the blast area. The resultant explosions ruptured and displaced the concrete from around the reinforcing rods, extending from the inside surface of the boreholes to points one to three feet above and below the horizontal boreholes. Some of the number 11 steel reinforcing rods were slightly stretched, many were not deformed in any way, and none was severed or so deformed as to damage the concrete beyond the area of the blast. Three vertical rods at each corner of each column were left intact and all other vertical rods were cut with an acetylene burning torch.

Two rows of vertical holes 2 3/4 inches diameter by 9.5 feet deep on 12 inches center to center, were drilled in the top of the concrete cap and located to divide the cap into one section approximately 16 feet long and two sections each 12 feet long. Each section of concrete was 11 feet high by 12 feet wide.

A row of horizontal holes was drilled in each column to separate the top cap from each column and two rows of horizontal holes were drilled in each column to divide each column into two sections, each approximately 16 feet high and 10 feet by 14 feet wide. This drilling was performed with a Gardner Denver Air Trac suspended on a platform and completed prior to any blasting and while McLean was installing a sheet pile cofferdam around pier 22.

The two rows of vertical holes in the top of the cap of pier 21 were loaded with each hole containing two lengths of 400 grain Primacord taped to a piece of 3/8 inch diameter plastic pipe, with three pieces of 7/8 inch diameter by 6 inches long Hercosplit dynamite taped between the two lengths of Primacord. Each assembled charge was primed with a Hercules electric blasting cap and each hole was stemmed with sand filled paper tamping bags. The blast areas were covered with rubber tire blasting mats and each row of holes was fired. The resultant explosions formed two fracture zones completely thru the concrete cap and exposed all reinforcing rods on all four faces of the cap. McLean attached a pair of 3 inch diameter wire rope cable slings around the center section of the cap, burned the supporting reinforcing steel, and lifted the 16 feet by 12 feet by 11 feet high block of concrete clear of the pier and placed it on a barge for later disposal.

Analysis of the results of the first block of concrete cut free from pier 21, indicated more efficient, clean cuts could be made in the concrete by eliminating some of the Hercosplit dynamite charges. Each of the next two blocks of concrete were cut with decreasing quantities of explosives and each section was effectively cut free from the pier columns. The results of each shot proved that even less explosives were required to shear the concrete and the fifth charge consisted of only two strands of 400 grain Primacord taped on each side of a length of 14 inch diameter plastic pipe, placed in every other hole. This charge formed a positive crack thru the entire concrete mass and effectively exposed all reinforcing rods for later burning and accomplished it with a minimum of violence and overbreak. Except for spelling of concrete on the faces of the columns and cosmetic scorching of the two concrete surfaces formed at the line of boreholes, when each explosion separated a concrete mass into two separate pieces, no other adverse effect on the concrete could be observed.

After each row of boreholes was shot, shearing the concrete, McLean burned all reinforcing rods still joining the block to the pier, and then lifted the concrete off the column and placed it on the barge. Eight rows of boreholes, charged and blasted in eight separate shots, sectioned all of pier 21 that protruded above water, into seven individual blocks of concrete.

While pier 21 was being dismantled down to water level,McLean was constructing a sheet pile cofferdam around pier 22 and dewatering the dam to approximately elevation minus 26. Inspection of the foundation resulted in the decision to retain the entire footing, remove the protruding column to the top of the strut wall and remove the stub of the other column in its entirety, but leave the connecting strut wall. All concrete must be removed to an exact line without any damage beyond that line and all reinforcing rods extending from the retained structure into the concrete to be demolished, must be kept intact to be used for reconstruction.

McLean used portable masonry saws and cut all four faces of the standing column approximately four inches deep, at the top of the strut wall elevation to create a smooth fracture line. Explosives Engineers, Inc. then proceeded to drill horizontal boreholes in the column and using the same technique as with pier 21, divided the fifty feet tall column into two separate lengths that were lifted from the pier and placed on a barge. The final surface left on top of the strut wall by removal of the column concrete above it, was clean and smooth but required laborers to use chipping hammers to chip approximately two inches of concrete off the top surface to fully expose the number 11 reinforcing rods forming the top mat on the strut wall. This allowed the newly constructed concrete column to be tied into the strut wall as previously constructed.

The stub of the other column required a separation to be made between the bottom of the column and the top of the footing and at the junction of the column to the strut wall. Again, McLean sawed approximately four inches deep on both sides and across the top of the strut wall to form a neat fracture line. Explosives Engineers, Inc. drilled a vertical row of 2 3/4 inch diameter horizontal holes from one side of the strut wall, through the wall and breaking out the far side, spaced as close as possible without intersecting, and aligned immediately ahead of the saw cuts. The thin concrete webs between the holes were then bisected with detonating cord. The horizontal reinforcing rods in the top mat were exposed and freed from the stub by drilling and blasting shallow holes drilled in the top of the stub. A horizontal hole was drilled on each of the three faces of the stub, immediately behind the vertical reinforcing rods extending up from the footing, and each hole was charged with a single strand of 400 grain Primacord taped to a length of plastic pipe, primed with a Hercules electric blasting cap, stemmed, and fired. This caused the concrete to spell from around all the vertical and horizontal reinforcing rods. By now the stub was thoroughly isolated from the truss wall and ready for demolition.

McLean constructed a sheet pile cofferdam around pier 21 and dewatered it to approximately elevation minus 23. Inspection resulted in the decision to remove both columns down to the footing but to leave the strut wall and the footing. This differed from pier 22 in that an additional column had to be separated from the footing and strut wall and the footing contained a horizontal crack parallel and approximately three feet below the top of the footing and passing entirely thru the footing.

Explosives Engineers, Inc. separated the bottom section of each column from the top of the strut wall by using the same technique that sectioned the upper columns. McLean lifted each block weighing approximately 150 tons and placed them on a barge.

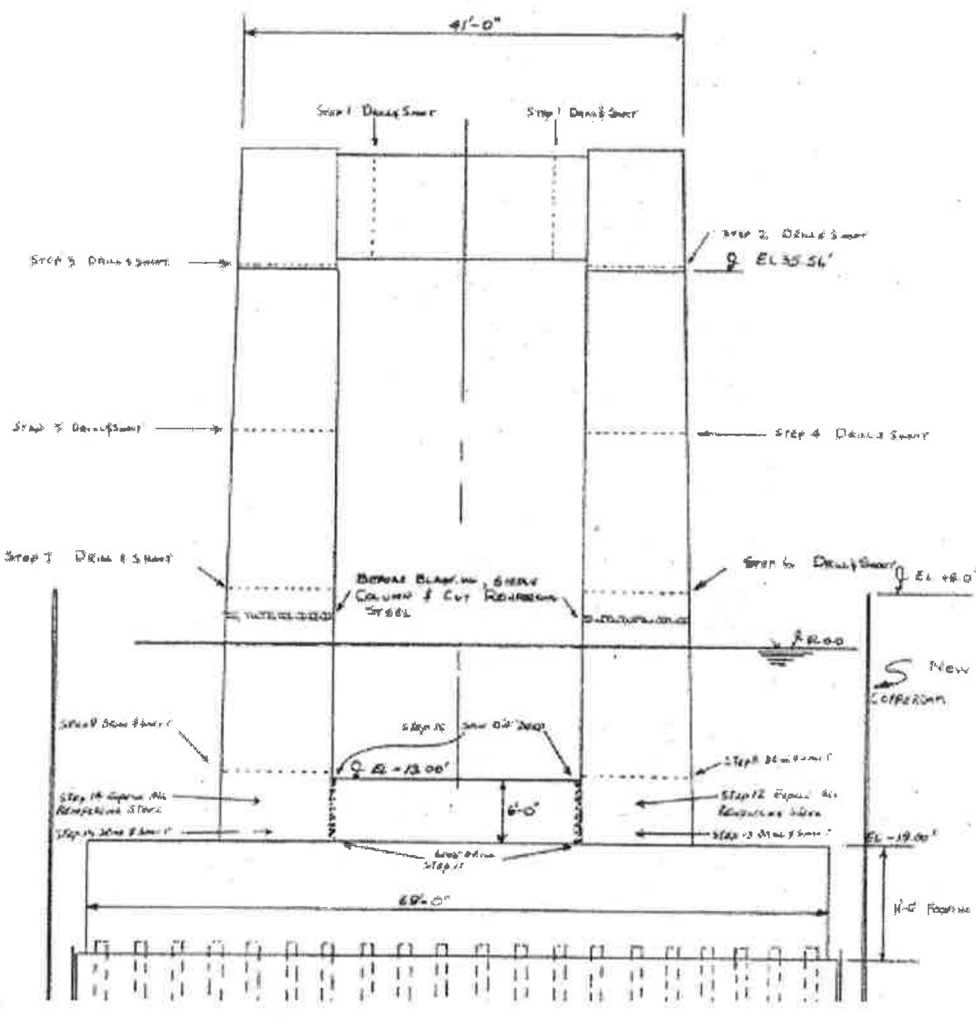
McLean created a final neat fracture line by sawing each of the three faces at both ends of the strut wall where it joined the base of each column and Explosives Engineers, Inc. drilled horizontal line holes behind each saw cut and shot out the webs between the line holes. To totally isolate each column stub, all reinforcing rods were exposed by drilling holes behind them and spelling the concrete from around the rods by detonating lengths of Primacord.

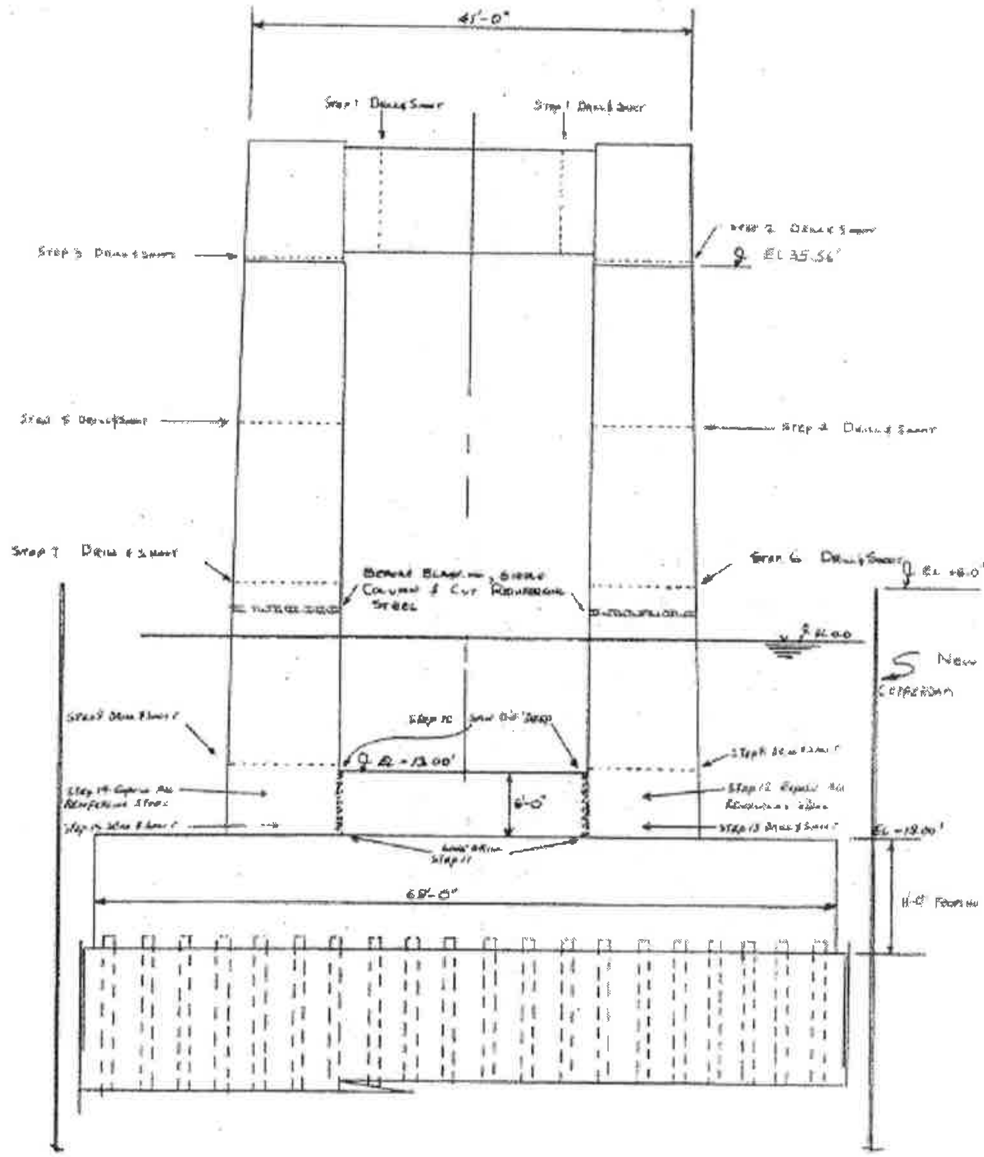
Each column stub was approximately 15 feet wide by 8 feet high by 10 feet from the end face to where it joined the strut wall. To just drill and blast and fragment this much concrete inside a very confining cofferdam would result in a tedious mucking problem for McLean. Since number 11 reinforcing steel completely encased the stub and must remain in place during and after demolition of the concrete, the normal use of a clamshell bucket could not be expected Again, using the same technique of drilling a row of vertical holes and using 400 grain Primacord Explosives Engineers, Inc. split off an individual block approximately 15 feet by 8 feet high by 3.5 feet thick. This block was lifted out of the cofferdam in one piece and the same procedure was repeated to sever the remaining part of the stub from the strut wall. Only several hours of hand held breaker work was required to clean up the area preparatory to reconstruction

The other remaining stub presented different problems because five 6 inch diameter curved steel conduit were embedded vertically in the concrete for the purpose of encasing cable that ran from the river bottom up thru the footing, into the column and up to the top of the pier. This conduit had to be protected from damage because new conduit would be spliced to it when the new column was to be reconstructed. This eliminated the possibility of splitting the stub into large individual blocks and necessitated drilling shallow holes and blasting light charges to fracture the concrete into small sizes. Because of the reinforcing rod remaining as a rectangular cage all blasted concrete from the stub was either lifted out by a crane and a sling attached to individual blocks or placed in a skip pan by laborers and then lifted out by a crane to complete the demolition work.

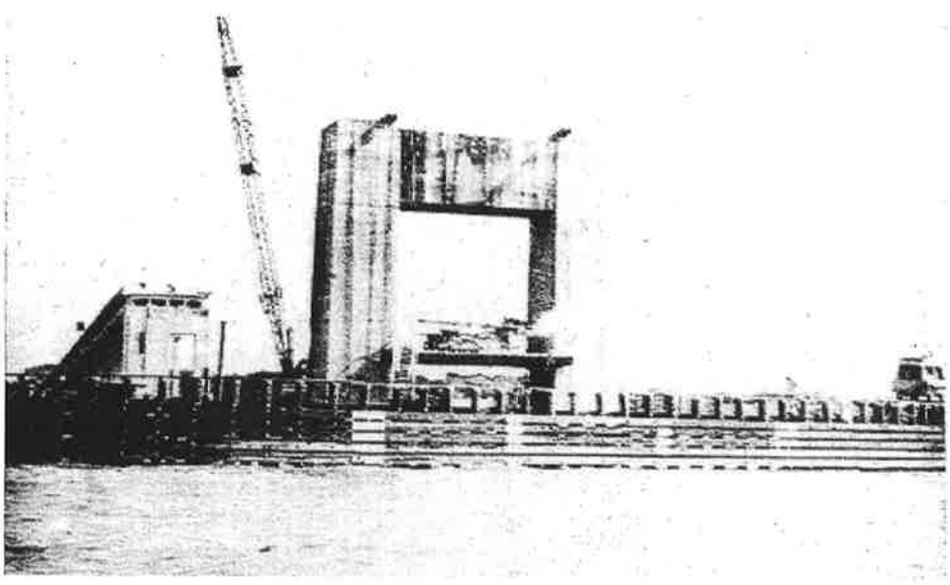
Explosives Engineers, Inc. then drilled 28 vertical holes 8 feet deep into the footing of pier 21 and McLean grouted in anchor bars to reinforce the damaged footing. The two piers were reconstructed on the existing footings and using the existing strut walls and reinforcing steel that remained after Explosives Engineers Inc. removed the concrete that encased the steel rods.

The demolition of the two concrete piers required a total of 36 work days for a drilling and blasting crew of three men and was completed on June 30, 1977. Approximately 1000 cubic yards of reinforced concrete was removed from the two piers. Of this total, approximately 850 cubic yards of concrete was sectioned and disposed of in 11 individual blocks, 60 cubic yards into 2 individual blocks, and the balance was fragmented in various sizes. All blasts were securely covered with rubber tire blasting mats and the clean, controlled cutting action that resulted from the technique used, minimized blast throw so that all blasted concrete remained within the cofferdams. Vibration from the blasts created less water leakage problem in the cofferdams than that caused by equipment striking against the sides of the steel dam. The blasting techniques enabled the demolition to be completed within the schedule and to successfully remove portions of massive reinforced concrete from a supporting structure without any harmful effects to the remaining structure.





ELEVATION PIER No 21



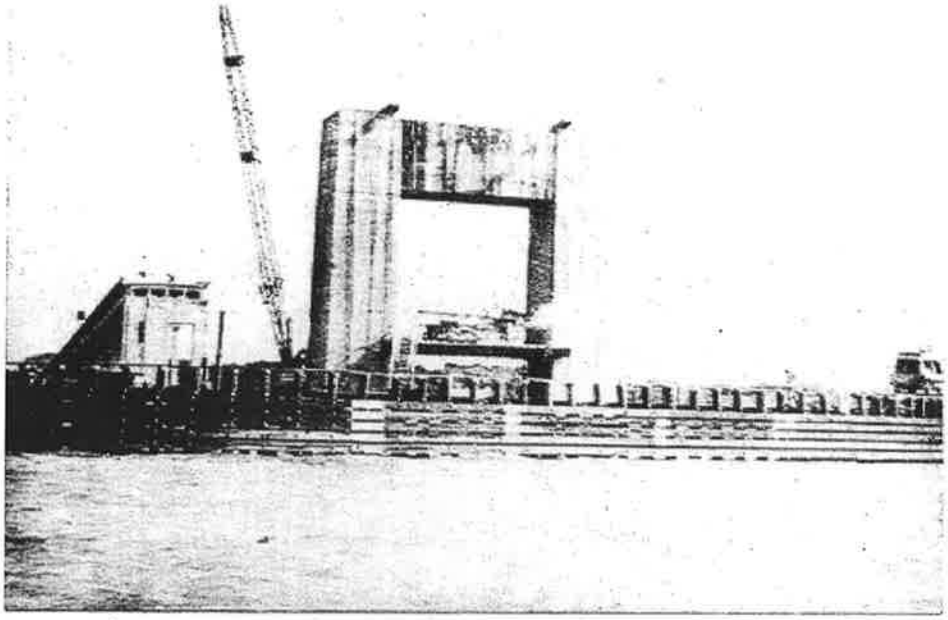


FIGURE 1 PIER 21

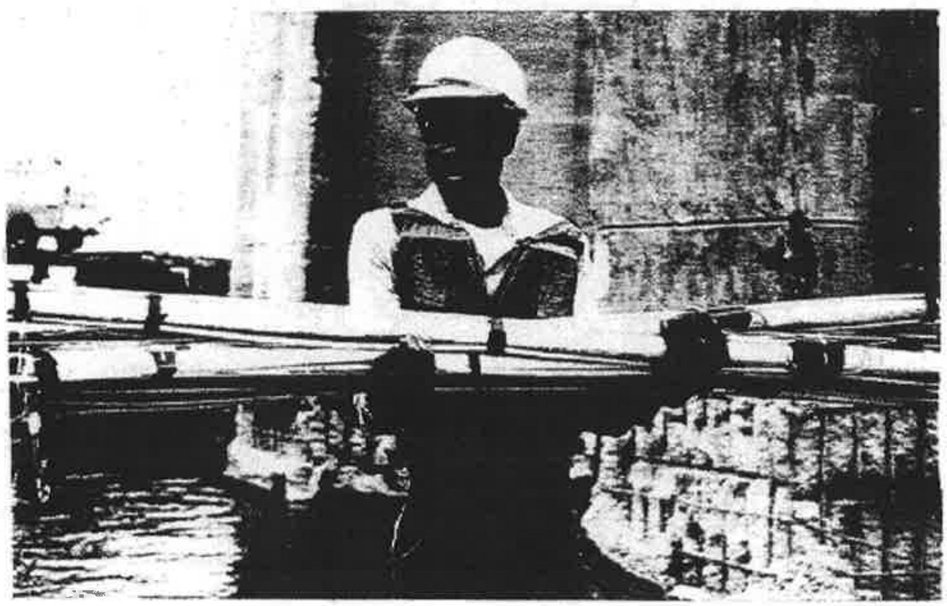


FIGURE 2 PREPARED CHARGES

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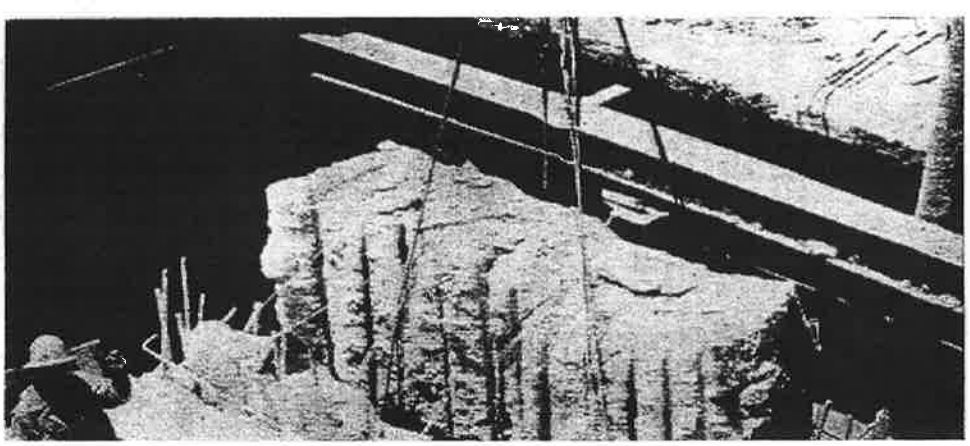

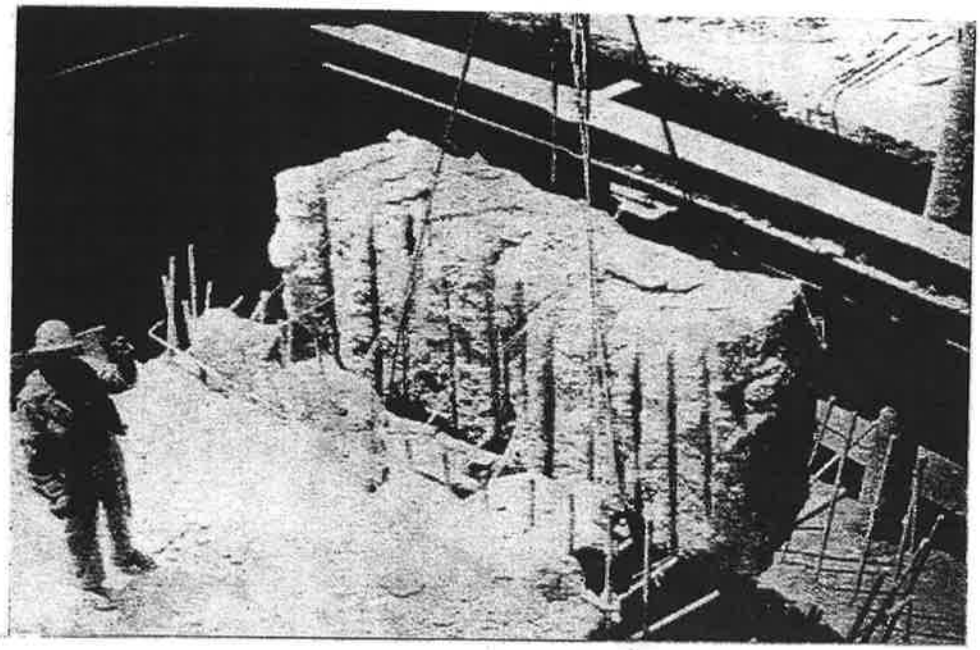

FIGURE 3 COLUMN BASE SEVERED FROM STRUT WALL

FIGURE 3 COLUMN BASE SEVERED FROM STRUT WALL

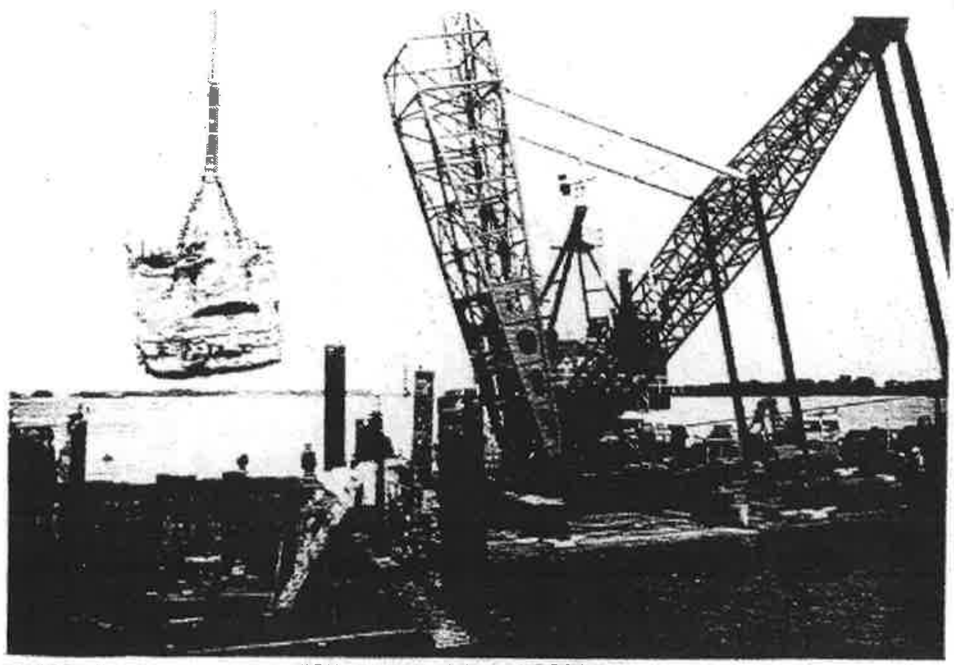

FIGURE 4 150 TON BLOCK OF CONCRETE

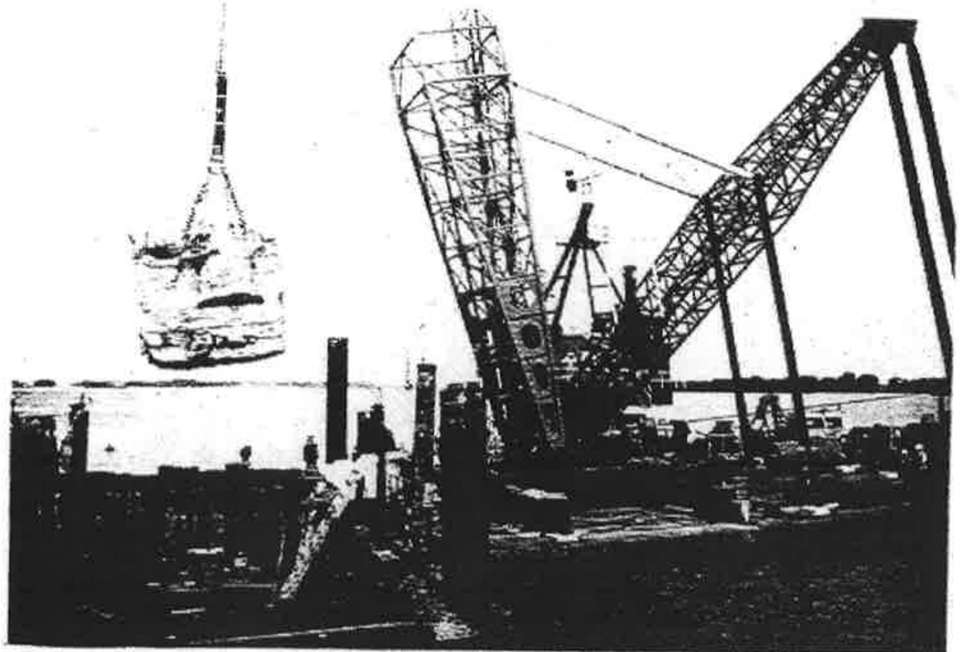

FIGURE 4 150 TON BLOCK OF CONCRETE

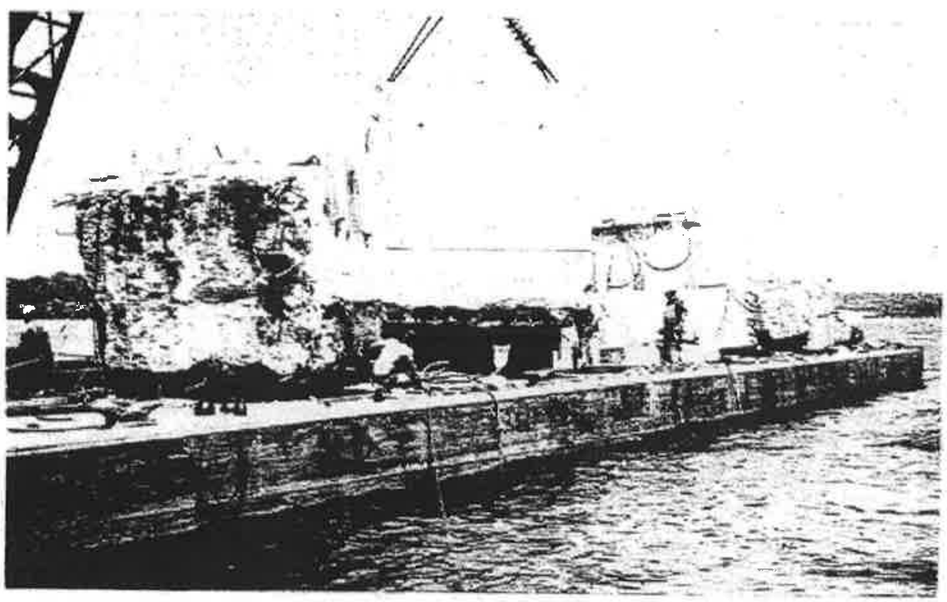

FIGURE 5 CONCRETE BLOCKS ON BARGE

FIGURE 5 CONCRETE BLOCKS ON BARGE

ATTACHMENT IV

SUMMARY OF ESTIMATED COSTS FOR THE BLAST DEMONSTRATION TESTS

Matilija Dam Blast Demonstration Testing Cost Estimate

Drill/Blast, Labor and Equipment Costs:

Assuumptions and Comments:

1. These are estimated costs that a drill-blast contractor (subcontractor) might use in his bid:
2. The cost of a support crane is included for duration of drill and blast test operations.
3. It is assumed that the drill/blast tests will last for two weeks duration but could extend to three weeks.
4. Minimum Equipment rental period is assumed to be one month.
5. Some equipment costs will be less if prime contractor does blasting without a subcontractor.
6. The labor costs are for three weeks; two for the work, one for setup.

Bid Item:	Unit Cost	Duration (months)	Quantity	**Totals:**
Equipment and Overhead:				
50-Ton Support Crane	$15,000 /mo	1.0	1	$15,000
Suspended Working Platform	$10,000 /mo	1.0	1	$10,000
Mobilization & Demobilization	$5,000 total		1	$5,000
Equipment modifications	$2,000 total		1	$2,000
Manager & Blaster Vehicles	$1,000 /mo	1.0	2	$2,000
Hand Drills, Rods and Bits	$5,000 /mo		1	$5,000
Wire cables, Slings, Skid Plates, etc.	$2,000 total		1	$2,000
Wire mesh and Rock bolts	$1,000 Total	1.0	1	$1,000
Harnesses & safety equipment	$1,500 Total		1	$1,500
Office Trailer	$1,000 /mo		1	$1,000
Travel & Subsitence Expenses	$4,000 /mo	1.0	1	$4,000
Misc. Supplies and Contingencies	$4,000 Total		1	$4,000
Seismographs	$500 /mo	1.0	2	$1,000
Explosives Related:				
Explosive Delivery Charges	$500 ea		4	$2,000
Blasting Permits & Dayboxes	$1,000 total		1	$1,000
Blasting Tools & Supplies:	$500 total		1	$500
Explosives & Initiators	$1,000 ea		1	$1,000
Drill/Blast Labor--including benefits:				
Manager	$6,500 /mo	0.75	1	$4,875
Blaster (Foreman)	$5,517 /mo	0.75	1	$4,138
Drillers	$5,417 /mo	0.75	2	$8,126
Laborers	$4,333 /mo	0.75	1	$3,250
SGA (includes insurance) @ 10% of Equip.,Labor, & Variable Costs.				$7,838.80
Total Work Costs				**$86,227**
Profit (15% of work costs)				**$12,934**
Total Estimated Bid Cost of Blasting Demonstration Work				**$99,161**

ATTACHMENT V

SPECIAL PROVISIONS FOR DRILL/BLAST WORK

SPECIAL PROVISIONS
BLASTING

PART 1 GENERAL

1.01 APPLICATION

A. This section covers the use of explosives in drill-and-blast tests designed to section concrete into blocks at the Matilija Dam.

1.02 REFERENCES

A. Code of Federal Regulations (CFR)

1. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Construction Standards and Interpretation, 29 CFR Part 1926

B. California Code of Regulations (CCR)

1. Title 8, General Industry Safety Orders, Subchapter 7, Group 18. Explosives and Pyrotechnics

C. Ventura County Noise Ordinances

D. Bureau of Alcohol Tobacco and Firearms (BATF)

1. Title XI, Regulation of Explosives (18 U.S.C. Chapter 40; 84 Statute 952), of the Organized Crime Control Act of 1970 (84 Statute 922) and 27 CFR 55.

E. Department Of Transportation (DOT)

1. Title 49 (49 CFR), Parts 106, 107, 171-179, 383 and 390-399

F. California Highway Patrol (CHP)

1. Title 8 and 13 CCR

1.03 DEFINITIONS

A. Dimension Stone (Concrete) Blasting —A form of controlled blasting used to break stone or concrete into cubic blocks of specific dimensions. With this method, lightly loaded charges are placed in close-spaced holes and fired simultaneously or with minimum time delays to create cleanly sheared planes within the rock or concrete

B. Peak Particle Velocity (ppv)—The maximum of the three ground vibration velocities measured in the vertical, longitudinal and transverse directions. Velocity units are expressed in inches per second (in/s).

C. Air overpressure—The increase in ambient air pressure caused by blasting. Air overpressure is expressed in units of psi or linear-scale decibels (dBL).

D. Occupied Building—Structure on or off construction limits that are occupied by humans or livestock.

E. Residential Building—Includes single and multi-family dwellings, hotels, motels, and any other structure containing sleeping quarters.

F. Scaled Distance—The distance from a blast measured in feet, divided by the square root of the charge per delay period measured in pounds. These "square root" scaled distance values are used in calculations regarding ground vibration prediction and control. For airblast calculations, cube root scaling is used whereby distance is divided by the cube root of the maximum charge per delay.

G. Line Drilling—A method of controlling overbreak, in which a series of very closely spaced holes are drilled at the perimeter of the excavation. Line holes are generally not loaded with explosives; however, in some applications alternating holes may be loaded with light charges using detonating cord .

H. Blastholes—Blast holes in the main body of the rock or concrete mass being removed, split or loosened by drilling and blasting.

I. Stemming—Crushed stone, sand, tamped clay or some other inert earth material placed in the unloaded collar area of blastholes for the purpose of confining explosive charges and limiting rock movement and airblast.

J. Primary Initiation—The method whereby the blaster initiates the blast(s) from a remote and safe location. Primary initiation systems use pneumatic tubing or shock-tubes to convey firing energy from blasters to blast locations.

K. Sub-drilling—The portion of a blasthole that is drilled below or beyond the desired excavation depth or limit. Subdrilling is generally required to prevent the occurrence of high or tight areas of unfractured rock between blastholes.

L. Controlled Blasting — Controlled blasting is a term that describes all techniques to reduce vibration, rock movement, air overpressure and damage to unfragmented rock or concrete.

1.04 SYSTEM DESIGN

A. Blast Execution Criteria

1. Blasting proctices shall include measures to prevent misfires and ensure the complete detonation of all explosives. If any products or methods are causing excessive cutoffs or other forms of misfires, the Engineer can require the Contractor to suspend the use of problematic products or methods. All associated costs of redesigned blasts or delays caused by this action will be at the Contractor's expense.

3. Blasting for Concrete Block Sectioning.

a. Drilling equipment shall be capable of safely drilling vertical and horizontal holes.

(1) The diameter of boreholes shall range between 1.5 and 1.75 inches.

(2) The spacing between holes for various test blasts will range between 6 to 18 inches.

b. Primary initiation of all blasts shall be done with detonators that can be remotely fired from a safe location.

1.05 SUBMITTALS

A. General

1. Unless otherwise indicated, make required submittals at least 30 days prior to conducting any blasting operations, and before any explosives, primers, or initiators are delivered to the job site.

B. Blasting Safety Plan

1. A blasting safety plan shall be prepared and submitted to the Engineer. Plans simply stating that "all regulations will be followed" shall not be acceptable. Plans shall include:

a. A complete description of the clearing and guarding procedures that will be employed to ensure personnel, staff, visitors, and all other persons are at safe locations during blasting. This information will include details regarding visible warning signs or flags, audible warning signals, method of determining blast area zones, access blocking methods, guard placement and guard release procedures, primary initiation method, and the system by which the blaster-in-charge will communicate with site security guards.

b. Detailed description of how explosives will be safely transported and used on site. Plans will explain how day-storage magazines (day boxes) and explosive transport vehicles (trucks and boats) will satisfy all applicable BATF, Cal/OSHA, federal, and County of Riverside regulations. This plan will also indicate how explosives will be inventoried, secured, and guarded to prevent theft or unauthorized use of explosives.

c. Include Material Safety Data Sheets (MSDS) and specific details about hazard communication programs for employees.

d. Equipment that will be used to monitor the approach of lightning storms and in the event of such, evacuation and site security plans.

e. Contingency plans for handling of misfires caused by cutoffs or other causes.

f. Fire prevention plan details, including, smoking policies, procedures and limitations for work involving any open flames or sparks, description and location of all fire fighting equipment, and fire fighting and evacuation plans.

g. Initial and ongoing blasting and fire safety training programs.

h. Description of the personal protective equipment that will be used by Contractor's personnel, including but not limited to safety glasses, hard-toe footwear, hard hats, gloves, and safety harnesses.

i. Description of blast monitoring equipment and listing of individuals that will operate such equipment. Submittal shall indicate that all equipment meets the standards defined in Section 2.02 of these specifications.

j. Description of railings, harnesses and other systems that will be used to protect workers from falls while performing drilling and blasting related work on the dam.

2. Obtain copies of all applicable codes, regulations, and ordinances, keep a copy in project files at all times, and provide the Engineer with a copy. The Contractor's Safety Manager shall ensure that ongoing blasting work complies with all applicable regulations.

3. Copies of any required CalOSHA variances.

C. Product Data

1. Manufacturer's product information sheets and Material Safety Data Sheets (MSDS) for all explosives, blasting agents, primers and initiator products, blasting devices, lightning detectors, blasting mats, and all other blasting equipment.

D. Quality Control Submittals

1. A detailed description of the education, training, and experience of all proposed persons that will be immediately in charge of drilling and blasting operations. The Contractors' submittal shall include names, addresses and telephone numbers of persons who can verify such prior successful experience. Copies of valid California blasting licenses shall also be submitted for all blasting supervisors. Blasting licenses shall indicate the class of license held by proposed blasting supervisors, i.e. surface, non-electric systems, etc.

2. The name and qualifications of a recognized blasting consultant(s) whom they plan to retain to facilitate the development or review of all blasting designs and blast-effect control measures. The qualifications of the blasting consultant(s) shall meet or exceed the requirements given in subparagraph 1.07A.3 of these specifications.

E. Pre-Construction Inspection Survey

1. Prepare and deliver to the Engineer, prior to the start of test blasting, two bound copies of the pre-blast inspection report detailing the existing condition of all structures, facilities and utilities within 500 feet of the Matilija Dam This report shall:

a. Include condition field notes.

b. Have photos and sketches or diagrams noting location of existing defects.

c. Include 2 copies of high-quality color 35-mm quality photos or Hi-8 quality video detailing condition of all dam structures, utilities and facilities within the specified 500-foot survey radius.

2. Data obtained from pre-inspections shall be delivered to the Engineer within 7 days of the date of inspection.

1.06 SCHEDULING AND SEQUENCING

A. Schedule blasting operations to minimize disturbance of the public.

B. Perform the pre-construction inspection as specified herein before conducting any blasting or other physical construction work that might impact the dam or surrounding facilities.

1.07 QUALITY ASSURANCE

A. Qualifications

1. The blasting supervisors (blasters-in-charge) shall have a minimum of 7 years of experience overseeing controlled construction blasting work.

2. All blasters and supervising shift foremen shall be properly qualified and licensed in accordance with applicable federal, state, and local government regulations.

3. Retain the services of an experienced specialist who will conduct the pre-construction inspection of the Dam. The specialist shall have performed similar pre-construction survey services on at least three projects of similar scope and complexity.

B. Monitor each blast using approved personnel and equipment conforming to the requirements outlined in section 2.02 as follows:

1. Seismographs to measure ground motion and instruments capable of measuring air overpressure:

a. In rock at the abutment nearest the blast location and at the _________ residence located at _______ Matilija Hot Springs Road.

1.08 DELIVERY, DAY-STORAGE AND HANDLING

A. Comply with federal, state, and local regulations, including Ventura County noise ordinances, applying to the purchase, transportation, day-storage, handling, and use of explosives, blasting agents, primers, initiators, and ancillary equipment and materials.

B. Transportation

1. When the amount of transported explosives exceeds 1,000 pounds, the delivering company will possess a valid hazardous materials transportation license—endorsed for explosives—issued by the California Highway Patrol (CCR, Title 13).
2. Where explosives are transported on public roads, the carriage shall be in accordance with 49 CFR.
3. If explosives are to be transported in interstate or foreign commerce, a license or users permit shall be secured from the (BATF) Bureau of Alcohol, Tobacco, and Firearms (27 CFR 55).
4. All onsite transportation of explosives shall conform to the most stringent requirements of CCR, Title 8.
5. A driver with a commercial drivers license and hazmat qualifications shall be present at all times when explosives are kept in delivery vehicles parked on site during working daytime hours.

C. On Site Day-Storage

1. The location, access, and construction of explosive day-storage magazines (day boxes) shall meet all requirements outlined in Title 8, General Industry Safety Orders, Subchapter 7, Group 18 and be in accordance with 27 CFR and all other applicable regulations.
2. The location of the day-storage magazines shall be no less than 100 feet away from open water and shall be easily accessed by work crews and delivery personnel.
3. No explosives shall be stored overnight and all explosive materials must be removed from the site before sunset.
4. Maintain inventory control of all blasting equipment and supplies. Copies of inventory logs and all shipping papers shall be kept by the contractor and be made available for review at the request of the Engineer.
6. Day-storage containers and transport boxes shall be identified with signs stating clearly and boldly, DANGEROUS EXPLOSIVES. Signs shall be attached to poles in plain sight from all approaches to the day-magazine site. Signs shall also include the warning "Never Fight Explosive Fires."

D. The aforementioned review of specific regulations shall not relieve the Contractor from his/her responsibility of knowing about and complying with all applicable regulations.

E. Explosive Losses to Ground or Water

Use great care to ensure that all possible measures are used to prevent explosive losses to ground by spillage, misfires or any other cause. If poor handling practices or blasting malfunctions cause excessive losses of explosives based on the Engineer's judgment all blasting in affected excavations shall cease until the Contractor submits a new explosive loss prevention plan that is approved by the Engineer.

1.09 WORKSITE CONDITIONS

A. This Statement of Concern is expressly written to alert the Contractor (or prospective bidders) to the fact that ordinary practices that are customarily considered as standard for the blasting industry will not be acceptable on this project. Extra caution and skill will be required to accomplish this work in a satisfactory manner. Blasting must be safely done in close proximity to water resources and existing dam facilities and utilities. Because of these concerns, the Engineer will exercise his prerogative to examine carefully the qualifications of any persons whose knowledge and skills may bear on the outcome of the work. In addition, the Engineer will reject any persons who are deemed unqualified for any tasks that may be required.

PART 2 PRODUCTS AND EQUIPMENT

2.01 EXPLOSIVE MATERIALS

A. Only fully non-electric blasting systems shall be used. Cap and fuse method shall not be used.

B. All explosives used shall be water-resistant.

C. Only explosives designed and manufactured for controlled blasting shall be used for this work. Such products include detonating cord as well as cartridged products. Loading density of any charges shall not exceed 0.25-lbs per lineal foot unless approved by the Engineer.

D. Explosives, blasting agents, primers, initiators, and ancillary blasting materials shall be kept in original packaging with clearly marked date codes. All explosives and initiating devices used shall be less than one year old.

E. If the Engineer determines that a blasting product appears to be in a damaged or deteriorated condition, the suspect product shall not be used until its condition can be determined. Products found to be damaged or in a deteriorated condition shall be immediately returned to the supplier for safe disposal..

2.02 BLAST MONITORING EQUIPMENT

A. Equipment for on-site and off-site particle velocity and air overpressure monitoring shall be 4-channel (1 overpressure and 3 seismic channels) units capable of digitally storing collected data. Equipment must be capable of printing ground motion time histories and summaries of peak motion intensities, frequencies and USBM RI8507 ppv--frequency plots. Printed report records must also include date, time of recording, operator name, instrument-number and date of last calibration.

1. Instruments shall have a flat frequency response between 2 and 250 Hz for particle velocity and from 2 to 200 Hz for air overpressure.
2. The digitizing sampling rate for peak particle velocity and air overpressure measurements shall be least 1,024 samples per second.
3. Seismographs shall be capable of performing a self-test of velocity transducers and printed event records shall indicate whether or not the sensor test was successful.
4. Seismographs used for off-site compliance monitoring shall be capable of recording overpressure from 88 to 148-dBL, and particle velocity from 0.01 to 10.0 in/sec.

PART 3 EXECUTION

3.01 GENERAL

Monitoring and recording of all blast effects, as required by these specifications, shall be performed by the Contractor. The Contractor shall monitor each blast at specified locations and other locations determined by the Engineer. Printed reports of all monitoring results including motion or overpressure time-histories shall be submitted to the Engineer before subsequent blasting occurs. The Contractor will save all digital monitoring record files to at least two separate disk locations of which one location is either an IBM-compatible 3-1/2 inch floppy disk or a Zip disk. Upon request, the Contractor shall submit copies of digitally recorded blast monitoring files to the Engineer. The Engineer may or may not perform blast monitoring

3.02 PREPARATION AND PROTECTION

A. The following warning systems, procedures and protection devices shall be established prior to blasting.

1. A system of audible signals to warn of impending blasts.
2. Signboards and flags indicating areas where blasting operations are occurring. These signs shall be clearly visible and legible from all points of access to the area. The signs shall clearly describe the audible signal system for warning of impending blasts. Blast area signs shall clearly indicate the length and nature of audible blast warning and all clear signals. All warning systems shall comply with the most stringent requirements of regulating local, state, and federal agencies.
3. The blaster-in-charge shall determine when to sound the five-minute warning signal. Blasting will be performed only after ensuring that all people and equipment have been removed to a safe location. The Engineer may have a representative with the blaster-in-charge.
4. Blasting shall occur only when a representative of the Engineer is present to witness each blast.

B. Flyrock Control

Rubber tire blasting mats shall be placed over blastholes to protect instrumentation, utilities, personnel, and equipment from flying material. Blasting mats shall be secured by cables or other means to prevent their loss of the Dam and into the water.

3.03 DRILLING AND BLASTING

A. The Contractor must use a vacuum system or some other means of containment to ensure that all drill cuttings and fluids do not leave the immediate work areas and enter water below or above the dam.

B. Perform blasting operations in a manner to minimize airblast and ground motion near occupied and residential buildings and critical on-site structures. If blast-induced air overpressure (airblast) or particle velocity exceeds the performance requirements specified herein suspend blasting in the affected excavation(s) until a re-designed blasting plan is submitted to and approved by the Engineer

C. The Contractor may need to employ special measures to meet the specified airblast limits. These measures might include, but are not be limited to, the use of: blasting mats or other cover on surface blasts, clay stemming in horizontal blastholes, sand or clay stemming in vertical blastholes, or other measures deemed necessary by the Engineer. Use the following controls to limit airblast (air overpressure) and flyrock as necessary for compliance with the specified air overpressure limits and for protection of both employees and the public.

D. Use extreme care to prevent spillage or loss of any explosives, oils or other pollutants to the ground, river or reservoir water. If any explosives or other pollutants are spilled, immediately clean up the spilled explosives and dispose of them by approved means. Spills of any amount must be reported to the Engineer immediately

E. All drill holes shall be collared to within 2 inches of the locations shown on the Contractors approved blasting plans.

F. Limitations

1. Blasting shall not be permitted when in the opinion of the Engineer it may be detrimental to existing installations. The Engineer's decision will be final.

G. Misfires and Dangerous Conditions

1. After a blast has been fired, the blaster-in-charge and one assistant under his or her direct supervision shall make a careful inspection of the blast area. The Engineer's representative may be present for this inspection. Inspections shall determine whether there are any indications that misfires might have occurred or whether the blast created any other imminent dangers like unstable ground conditions. If misfires or other dangerous conditions are found, the blaster-in-charge will secure the area and properly correct all hazards before any other work is allowed in the affected area. The all clear signal, allowing other work to resume in the area, shall not be given until affected blast sites are clear of all hazards.

3.04 SUSPENSION OF BLASTING

A. Blasting operations may be suspended by the Engineer for any of the following reasons:

1. The Contractor's safety precautions are inadequate.
2. Flyrock, air overpressure, ground motion levels, and water over-pressures exceed specified limits.
3. Drilling and blasting work pollutes water resources or damages nearby facilities or utilities.
4. The results of the blasting, in the opinion of the Engineer, are not satisfactory.

B. Blasting operations shall not resume until the Engineer has approved the Contractor's revised blasting safety plan with modifications correcting the conditions causing the suspension.

3.05 DAMAGE REPAIR

A. If blasting operations cause any damage to structures or utilities, or a portion of the work, or material surrounding or supporting the work, the contractor shall promptly repair or replace damaged items to the condition that existed prior to the damage, to the satisfaction of the Engineer.

B. Nothing contained herein shall relieve the Contractor of his responsibility for claims arising from his construction operations. Failure to inspect any structure required by these contract documents, or inadequacy of the inspections shall not relieve the Contractor of his responsibility.

END OF SECTION

SPECIAL PROVISIONS
BLASTING

PART 1 GENERAL

1.01 APPLICATION

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3. Blasting for Concrete Block Sectioning.

a. Drilling equipment shall be capable of safely drilling vertical and horizontal holes.

(1) The diameter of boreholes shall range between 1.5 and 1.75 inches.

(2) The spacing between holes for various test blasts will range between 6 to 18 inches.

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h. Description of the personal protective equipment that will be used by Contractor's personnel, including but not limited to safety glasses, hard-toe footwear, hard hats, gloves, and safety harnesses.

i. Description of blast monitoring equipment and listing of individuals that will operate such equipment. Submittal shall indicate that all equipment meets the standards defined in Section 2.02 of these specifications.

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1. Prepare and deliver to the Engineer, prior to the start of test blasting, two bound copies of the pre-blast inspection report detailing the existing condition of all structures, facilities and utilities within 500 feet of the Matilija Dam This report shall:

a. Include condition field notes.

b. Have photos and sketches or diagrams noting location of existing defects.

c. Include 2 copies of high-quality color 35-mm quality photos or Hi-8 quality video detailing condition of all dam structures, utilities and facilities within the specified 500-foot survey radius.

2. Data obtained from pre-inspections shall be delivered to the Engineer within 7 days of the date of inspection.

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A. Schedule blasting operations to minimize disturbance of the public.

B. Perform the pre-construction inspection as specified herein before conducting any blasting or other physical construction work that might impact the dam or surrounding facilities.

1.07 QUALITY ASSURANCE

A. Qualifications

1. The blasting supervisors (blasters-in-charge) shall have a minimum of 7 years of experience overseeing controlled construction blasting work.

2. All blasters and supervising shift foremen shall be properly qualified and licensed in accordance with applicable federal, state, and local government regulations.

3. Retain the services of an experienced specialist who will conduct the pre-construction inspection of the Dam. The specialist shall have performed similar pre-construction survey services on at least three projects of similar scope and complexity.

B. Monitor each blast using approved personnel and equipment conforming to the requirements outlined in section 2.02 as follows:

1. Seismographs to measure ground motion and instruments capable of measuring air overpressure:

a. In rock at the abutment nearest the blast location and at the ________ residence located at _______ Matilija Hot Springs Road.

1.08 DELIVERY, DAY-STORAGE AND HANDLING

A. Comply with federal, state, and local regulations, including Ventura County noise ordinances, applying to the purchase, transportation, day-storage, handling, and use of explosives, blasting agents, primers, initiators, and ancillary equipment and materials.

B. Transportation

1. When the amount of transported explosives exceeds 1,000 pounds, the delivering company will possess a valid hazardous materials transportation license—endorsed for explosives—issued by the California Highway Patrol (CCR, Title 13).
2. Where explosives are transported on public roads, the carriage shall be in accordance with 49 CFR.
3. If explosives are to be transported in interstate or foreign commerce, a license or users permit shall be secured from the (BATF) Bureau of Alcohol, Tobacco, and Firearms (27 CFR 55).
4. All onsite transportation of explosives shall conform to the most stringent requirements of CCR, Title 8.
5. A driver with a commercial drivers license and hazmat qualifications shall be present at all times when explosives are kept in delivery vehicles parked on site during working daytime hours.

C. On Site Day-Storage

1. The location, access, and construction of explosive day-storage magazines (day boxes) shall meet all requirements outlined in Title 8, General Industry Safety Orders, Subchapter 7, Group 18 and be in accordance with 27 CFR and all other applicable regulations.
2. The location of the day-storage magazines shall be no less than 100 feet away from open water and shall be easily accessed by work crews and delivery personnel.
3. No explosives shall be stored overnight and all explosive materials must be removed from the site before sunset.
4. Maintain inventory control of all blasting equipment and supplies. Copies of inventory logs and all shipping papers shall be kept by the contractor and be made available for review at the request of the Engineer.
6. Day-storage containers and transport boxes shall be identified with signs stating clearly and boldly, DANGEROUS EXPLOSIVES. Signs shall be attached to poles in plain sight from all approaches to the day-magazine site. Signs shall also include the warning "Never Fight Explosive Fires."

D. The aforementioned review of specific regulations shall not relieve the Contractor from his/her responsibility of knowing about and complying with all applicable regulations.

E. Explosive Losses to Ground or Water

Use great care to ensure that all possible measures are used to prevent explosive losses to ground by spillage, misfires or any other cause. If poor handling practices or blasting malfunctions cause excessive losses of explosives based on the Engineer's judgment all blasting in affected excavations shall cease until the Contractor submits a new explosive loss prevention plan that is approved by the Engineer.

1.09 WORKSITE CONDITIONS

A. This Statement of Concern is expressly written to alert the Contractor (or prospective bidders) to the fact that ordinary practices that are customarily considered as standard for the blasting industry will not be acceptable on this project. Extra caution and skill will be required to accomplish this work in a satisfactory manner. Blasting must be safely done in close proximity to water resources and existing dam facilities and utilities. Because of these concerns, the Engineer will exercise his prerogative to examine carefully the qualifications of any persons whose knowledge and skills may bear on the outcome of the work. In addition, the Engineer will reject any persons who are deemed unqualified for any tasks that may be required.

PART 2 PRODUCTS AND EQUIPMENT

2.01 EXPLOSIVE MATERIALS

A. Only fully non-electric blasting systems shall be used. Cap and fuse method shall not be used.

B. All explosives used shall be water-resistant.

C. Only explosives designed and manufactured for controlled blasting shall be used for this work. Such products include detonating cord as well as cartridged products. Loading density of any charges shall not exceed 0.25-lbs per lineal foot unless approved by the Engineer.

D. Explosives, blasting agents, primers, initiators, and ancillary blasting materials shall be kept in original packaging with clearly marked date codes. All explosives and initiating devices used shall be less than one year old.

E. If the Engineer determines that a blasting product appears to be in a damaged or deteriorated condition, the suspect product shall not be used until its condition can be determined. Products found to be damaged or in a deteriorated condition shall be immediately returned to the supplier for safe disposal..

2.02 BLAST MONITORING EQUIPMENT

A. Equipment for on-site and off-site particle velocity and air overpressure monitoring shall be 4-channel (1 overpressure and 3 seismic channels) units capable of digitally storing collected data. Equipment must be capable of printing ground motion time histories and summaries of peak motion intensities, frequencies and USBM RI8507 ppv--frequency plots. Printed report records must also include date, time of recording, operator name, instrument-number and date of last calibration.

1. Instruments shall have a flat frequency response between 2 and 250 Hz for particle velocity and from 2 to 200 Hz for air overpressure.
2. The digitizing sampling rate for peak particle velocity and air overpressure measurements shall be least 1,024 samples per second.
3. Seismographs shall be capable of performing a self-test of velocity transducers and printed event records shall indicate whether or not the sensor test was successful.
4. Seismographs used for off-site compliance monitoring shall be capable of recording overpressure from 88 to 148-dBL, and particle velocity from 0.01 to 10.0 in/sec.

PART 3 EXECUTION

3.01 GENERAL

Monitoring and recording of all blast effects, as required by these specifications, shall be performed by the Contractor. The Contractor shall monitor each blast at specified locations and other locations determined by the Engineer. Printed reports of all monitoring results including motion or overpressure time-histories shall be submitted to the Engineer before subsequent blasting occurs. The Contractor will save all digital monitoring record files to at least two separate disk locations of which one location is either an IBM-compatible 3-1/2 inch floppy disk or a Zip disk. Upon request, the Contractor shall submit copies of digitally recorded blast monitoring files to the Engineer. The Engineer may or may not perform blast monitoring

3.02 PREPARATION AND PROTECTION

A. The following warning systems, procedures and protection devices shall be established prior to blasting.

1. A system of audible signals to warn of impending blasts.
2. Signboards and flags indicating areas where blasting operations are occurring. These signs shall be clearly visible and legible from all points of access to the area. The signs shall clearly describe the audible signal system for warning of impending blasts. Blast area signs shall clearly indicate the length and nature of audible blast warning and all clear signals. All warning systems shall comply with the most stringent requirements of regulating local, state, and federal agencies.
3. The blaster-in-charge shall determine when to sound the five-minute warning signal. Blasting will be performed only after ensuring that all people and equipment have been removed to a safe location. The Engineer may have a representative with the blaster-in-charge.
4. Blasting shall occur only when a representative of the Engineer is present to witness each blast.

B. Flyrock Control

Rubber tire blasting mats shall be placed over blastholes to protect instrumentation, utilities, personnel, and equipment from flying material. Blasting mats shall be secured by cables or other means to prevent their loss of the Dam and into the water.

3.03 DRILLING AND BLASTING

A. The Contractor must use a vacuum system or some other means of containment to ensure that all drill cuttings and fluids do not leave the immediate work areas and enter water below or above the dam.

B. Perform blasting operations in a manner to minimize airblast and ground motion near occupied and residential buildings and critical on-site structures. If blast-induced air overpressure (airblast) or particle velocity exceeds the performance requirements specified herein suspend blasting in the affected excavation(s) until a re-designed blasting plan is submitted to and approved by the Engineer

C. The Contractor may need to employ special measures to meet the specified airblast limits. These measures might include, but are not be limited to, the use of: blasting mats or other cover on surface blasts, clay stemming in horizontal blastholes, sand or clay stemming in vertical blastholes, or other measures deemed necessary by the Engineer. Use the following controls to limit airblast (air overpressure) and flyrock as necessary for compliance with the specified air overpressure limits and for protection of both employees and the public.

D. Use extreme care to prevent spillage or loss of any explosives, oils or other pollutants to the ground, river or reservoir water. If any explosives or other pollutants are spilled, immediately clean up the spilled explosives and dispose of them by approved means. Spills of any amount must be reported to the Engineer immediately

E. All drill holes shall be collared to within 2 inches of the locations shown on the Contractors approved blasting plans.

F. Limitations

1. Blasting shall not be permitted when in the opinion of the Engineer it may be detrimental to existing installations. The Engineer's decision will be final.

G. Misfires and Dangerous Conditions

1. After a blast has been fired, the blaster-in-charge and one assistant under his or her direct supervision shall make a careful inspection of the blast area. The Engineer's representative may be present for this inspection. Inspections shall determine whether there are any indications that misfires might have occurred or whether the blast created any other imminent dangers like unstable ground conditions. If misfires or other dangerous conditions are found, the blaster-in-charge will secure the area and properly correct all hazards before any other work is allowed in the affected area. The all clear signal, allowing other work to resume in the area, shall not be given until affected blast sites are clear of all hazards.

3.04 SUSPENSION OF BLASTING

A. Blasting operations may be suspended by the Engineer for any of the following reasons:

1. The Contractor's safety precautions are inadequate.
2. Flyrock, air overpressure, ground motion levels, and water over-pressures exceed specified limits.
3. Drilling and blasting work pollutes water resources or damages nearby facilities or utilities.
4. The results of the blasting, in the opinion of the Engineer, are not satisfactory.

B. Blasting operations shall not resume until the Engineer has approved the Contractor's revised blasting safety plan with modifications correcting the conditions causing the suspension.

3.05 DAMAGE REPAIR

A. If blasting operations cause any damage to structures or utilities, or a portion of the work, or material surrounding or supporting the work, the contractor shall promptly repair or replace damaged items to the condition that existed prior to the damage, to the satisfaction of the Engineer.

B. Nothing contained herein shall relieve the Contractor of his responsibility for claims arising from his construction operations. Failure to inspect any structure required by these contract documents, or inadequacy of the inspections shall not relieve the Contractor of his responsibility.

END OF SECTION