APPENDIX A

ROCK CRUSHER/QUARRY OPERATION

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TABLES

INTRODUCTION

This was prepared to be used by MCBs in the operation, maintenance, and control of the crusher/quarry operations. The purpose is to provide guidelines for increasing efficiency in the productive operation, maintenance, staffing and equipment utilization of crusher/quarry operations.

This is not intended to supercede any instruction that is presently in use. Instead, it is intended for use as guidelines and helpful hints to the Battalions that are tasked with the operation of crushers. The manpower requirements stated herein are based solely upon average Seabee conditions, i.e., average age of crusher not to exceed 5 years, average length haul, and average type rock to be crushed. If conditions other than average exist, then manpower and equipment requirements would need to be altered to suit the situation.

These suggestions and helpful hints are based on the assumption that the operating crews have graduated from the quarry/crusher school in home port; also, that the CPO in charge has had some experience related to this operation.

I. TYPES OF QUARRIES AND DETERMINATION OF REQUIREMENTS

A. QUARRY TYPES AND SITE SELECTIONS.

Selection of the quarry site and crusher site should be made while observing the following conditions:

(1) Locate both the quarry and crusher as close as possible to where the product is going to be used.

(2) Locate the quarry and crusher as close as possible to each other to shorten the haul road between them. This will conserve time and expense in building and maintaining the road and will shorten the haul.

(3) Locate the crusher an adequate distance from the quarry to be safe from flying rocks.

Types of quarries are generally determined (except commercial quarries) by the physical and natural features of the surrounding land area. If the area is hilly, the type of quarry usually chosen will be a sidehill, two-bench or three-bench operation, which starts at the top of a small hill and benches down toward the bottom. If the terrain is flat and the rock is not more than five to ten feet beneath the surface, a pit-type quarry could be made operational. If the ground water table is within five feet of the surface, however, drainage must be prime consideration. If adequate drainage is not available and a pumping system must be installed, the operation of a pit-type quarry may prove to be unprofitable.

The majority of quarry sites are selected with the projected goal of producing several different products. The quality and quantity of the products must be adequate enough to support building projects, concrete projects, and road-building projects both concrete and asphalt.

The selection of quarry sites is based on visual inspection and the use of a dozer for exploration work. The MCBs do not usually have a core drill available for test drilling. The use of core drill is not practical in RVN, or anyplace where combat conditions exist. The time involved to core drill a 100 foot hole is 2 to 3 days and once a hole is started, the drill cannot be moved until the hole is finished. Security is a vital problem in these cases.

It is very difficult to lay down strict guidelines for the opening or development of quarry sites. Each site will have different characteristics. The site may be heavily wooded or have extra heavy bush. The trees and brush should be removed and burned. The equipment for overburden removal depends upon the type of earth to be removed. If the overburden is semi-hard, such as, decomposed granite or large boulders mixed with overburden, the use of a ripper-cat and/or a shovel and dump trucks may be necessary. In any case, the material should be moved far enough that it would not require further handling.

The quantity of material needed in finished product form should be determined and every effort should be made to assure that the estimate of in-place material required is adequate to prevent the necessity of opening a second site at a later date.

To convert from quantity in-place to finished product quantity, multiply in-place yardage times 1.5. If tonnage estimate of in-place material is desired, use two tons per cubic yard.

The quarry site should be located as close as possible to the construction site to reduce the hauling distance. It should be located close to good existing roads to minimize the construction of access roads.

Determining the efficiency, convenience, and ease with which a site can be worked involves a number of considerations:

The drainage of quarries is of prime importance as it is necessary that they be worked as dry as possible. The drainage problem varies with the location of the site.

A hilltop quarry will generally drain by natural run-off if no holes are dug in the center. The outside perimeter of the site must be maintained slightly lower than the center.

Draining a hillside quarry can be accomplished by several methods:

a. A dike on the uphill side with ditches down the sidehill slope.
b. A ditch on the uphill side and ditches on both sides of the quarry.

A pit-type quarry lower than the surrounding area is the most difficult to drain. A pump system is generally the method used.

The operations plan should be prepared before moving any earth. The limits of the area to be developed must be determined, methods of excavation chosen, equipment selected, locations of all structures, equipment and stockpiles determined, and a plan for supervision of traffic control established.

If the area is wooded, the first operation in preparing the site is the clearing of all timber, standing and fallen. Timbers of suitable dimensions should be stockpiled for possible future use in the construction of loading ramps, headwalls and for pits or storage for quarries.

The method and equipment used for removal of overburden from quarries vary with its depth, the distance it must be moved, and the type of excavation planned. In dry sites, where overburden is less than 5 feet in depth and is moved less than 300 feet, dozing is the most expeditious method. Overburden should be removed until the surface of the rock is laid bare, always keeping enough area cleared to keep well ahead of rock excavation, it should always be kept cleared at least 20 feet from the face of the quarry to prevent rock and other material from falling on personnel working at the toe of the face.

Rock bars in a river usually provide the most ideal site for crusher/quarry operation. The rocks found in the bars are deposited and accumulated by water currents, consequently, they are sized and very few oversized rocks are found. The rock-bar-type quarry is the most profitable operation because it is not necessary to engage a drilling crew and a blasting crew, or rock drills and compressors.

B. PERSONNEL AND EQUIPMENT

1. Personnel

The manpower requirements for a 200-TPH crusher, one-shift operation are presented in Table 1. The requirements of the second shift of a two-shift operation are presented in Table 2. The total manpower requirements for a two-shift operation are presented in Table 3. The requirements for support personnel for a one-shift operation can be found in Table 4.

Table 1. Manpower Requirements - One-Shift Operation

	CM	EO	CE	SW	MR	YN/SK	TOTAL
E-9	-	1	-	-	-	-	1
E-8	-	-	-	-	-	-	-
E-7	1	-	-	-	-	-	1
E-6	1	4	-	-	1	-	6
E-5	4	14	1	2	-	1	22
E-4	7	18	-	-	-	2	27
E-3	1	3	-	-	-	-	4
TOTAL	14	40	1	2	1	3	61

Table 2. Manpower Requirements - Second Shift

	CM	EO	CE	SW	MR	YN/SK	TOTAL
E-9	-	-	-	-	-	-	-
E-8	-	-	-	-	-	-	-
E-7	-	1	-	-	-	-	1
E-6	1	3	-	-	-	-	4
E-5	1	12	-	1	1	-	15
E-4	-	16	1	-	-	-	17
E-3	1	1	-	-	-	-	2
TOTAL	3	33	1	1	1	-	39

Table 3. Total Manpower Requirements - Two-Shift Operation

	CM	EO	CE	SW	MR	YN/SK	TOTAL
E-9	-	1	-	-	-	-	1
E-8	-	-	-	-	-	-	-
E-7	1	1	-	-	-	-	2
E-6	2	7	-	-	1	-	10
E-5	5	26	1	3	1	1	37
E-4	7	34	1	-	-	2	44
E-3	2	4	-	-	-	-	6
TOTAL	17	73	2	3	2	3	100

Table 4. Support Personnel Requirements - One Shift

	Day Shift	Night Shift
OIC	1 LT or LTJG	
AOIC	1 ENS	
Leading Chief	1 EQCM	1 ECC
Yeoman	1 YN2	
Dispatcher/Timekeeper	1 YN3	
Storekeeper	1 SK3	
SRO Clerk	1 EO3	

2. Equipment

The basic equipment requirements for crusher/quarry operation are as follows:

Table 5. Crusher/Quarry Equipment Requirements

1	200-ton Primary Crusher
1	200-ton Secondary Crusher
1	Screening Plant
4	Conveyors
1	Front-End Loader (2Y)
1	TD-20 Dozer
2	D-8 Dozer
1	Forklift
1	Cherry Picker
3	Shovels (1-1/2 yd)
3	Welding Machines (600 AMP) Automatic
7	Light Plants (15 KW)
3	Generators (100 KW)
8	Track Drills
8	Compressors (600 CFM ea)

Table 5. Crusher/Quarry Equipment Requirements (Continued)

5	Rock Dumps (15 ton)
1	Weapons Carrier
2	Jeeps
1	6x6 Cargo Truck
1	Water Truck
1	Fuel Tank
1	Lub/Field Truck
1	Grader
3	Pumps (two 2-inch, one 3-inch)
1	Machine shop trailer

3. Equipment Staffing Requirements

Staffing requirements for operation of the quarry/crusher (200/ton/hour) and the shop are presented in Tables 6, 7, and 8 respectively. The associated tools necessary for each operation have been included with each table.

Table 6. Quarry Staffing Requirements

Staffing and Equipment	Day Shift	Night Shift
Supervision	1 EO1	1 EO1
Blasting Crew	1 EO1	-
Blasting Crew	1 EO2	-
Blasting Crew	1 EO3	-
Blasting Crew	1 CN	-
3 D-8	2 EO2	2 EO2
3 D-8	1 EO3	-
8 Drills	1 EO1	1 EO1
8 Compressors	4 EO2	1 EO2
- - - - - - -	5 EO3	5 EO3
3 Shovels (1-1/2 yd)	2 EO2	2 EO2
- - - - - - -	2 EO3	2 EO3
5 Rock Dumps (15 ton)	1 EO2	1 EO2
- - - - - - -	3 EO3	3 EO3
- - - - - - -	1 EO2	1 EO3
Grader		
6 Light Plants (15 KW)		
1000 Blasting Machine		
1 6x6 Cargo Truck		
1 Weapons Carrier		
1 Vibrating Compactor		

NOTE: Climatic conditions such as, extreme cold or extreme heat, would probably have a bearing on the size crews used either on day shift or night shift. The decision for crew size changes due to climatic conditions would need to be made by the supervisors at the quarry site.

Tools

1 Set of Pullers
1 Set of Soil Testing Equipment

II. OPERATION AND CONTROL PROCEDURES

A. CRUSHER

1. Installation

During installation of the crusher, care must be taken to insure that the unit is level. Conservation of space and availability of service space must be considered. The distance between the quarry and the crusher should be considered very carefully as flying rocks from quarry blasts could damage crusher.

During the complete crusher operation, each crusher unit must be checked frequently to insure that the cribbing has not moved or settled. The primary unit, secondary unit, and the screening unit must be level at all times.

If time is available, each unit should be placed on concrete foundations. Select an area of sufficient space to set up the plant which will permit good truck circulation for moving the material away from the plant. If concrete is not available, the plant can be set on the attached jacks. Place underneath the jacks 3" x 12" planking with the required cribbing for leveling. If load carrying capacity of the soil is low, it may be necessary to place additional planking under the cribbing to increase the bearing area. Crib crusher high enough above ground level to allow for cleaning and service work.

Upon completion of plant site preparation and foundation construction, crushing plant should be moved into position, assembled on concrete foundation and/or cribbing. New crushers arrive at the worksite partially disassembled; therefore, the assembly instructions in the manual of the manufacturer should be followed.

Level the plant both lengthwise and crosswise with a carpenter's level. Level across the frame at the elevating wheel, jaw crusher and the intake end of the screen. Level lengthwise on both sides of the frame at the front and rear of the plant. A twist in the frame of a unit improperly leveled, will cause excessive vibrations resulting in metal fatigue and complete failure of the crushing unit.

To assemble the V-belts, loosen the adjustment bolts enough to allow the belts to be placed over the sheave. Assemble a matched set of belts on the sheave and tension the belts with the adjustment bolts, making sure to maintain the parallel position of the sheaves.

Conveyor belts are shipped separated from the plant except the return belt which is always shipped in the crusher.

When assembling conveyor belts, be sure the ends being laced together are cut square. Make sure of the alignment. Make certain before assembling belt on conveyor frame that the side of the belt with the thickest rubber covering is on the load side.

Layout and erection of the crusher can be accomplished within a time frame of three to six weeks, depending upon the site conditions. The operating crew augmented by a four-man BU crew for headwall and culvert construction is sufficient for this task. If heavy overburden is anticipated, and the stripping material must be wasted away from the site, one or two scrapers, of a capacity equal to a MRS or TS24, should be added.

After set up and test run the crusher should be in operation for 24 to 36 hours before hard facing the high impact areas. By this process the metal on the high wear areas will be tempered and better adaptable to hard facing.

2. V-Belt Rock Guards

During the initial installation, rock guards for the V-belts should be mounted on the crusher. In most cases rock guards are not furnished by the

manufacturer and must be fabricated by the welders. The use of rock guards will almost double the life of V-belts.

3. Headwall

When building the headwall for the primary unit, the height should be compatible with the height of the primary unit so that rock from the dump truck would have no greater drop than necessary onto the flight feeder pans. This will eliminate unnecessary damage to the primary unit.

B. QUARRY

1. Benches

Benches in the quarry should be kept neat and square. The floor of the quarry should be maintained clean and level at all times to enhance the maneuvering of quarry equipment. The size benches in a quarry is determined by the equipment that is used. Generally, the quarry equipment used by MCBs is 1-1/2 to 2 yard shovels and track drills with a 450 or 475 drifter. It is not practical to dig a higher face than 20 to 25 feet with two yard shovel as the bucket will not reach high enough to bring down rock from the top of the slope. The drills used by the MCBs are best adapted to drill 20 to 30 feet of hole thereby, making a 20 foot face more practical. After the rock is laid bare and the drilling equipment and rock removal equipment is working, benches or working levels should be established. The most convenient benches appear to be 40 feet wide with 20 foot face. The type of equipment used by the MCBs is most adaptable to this size bench.

The overburden removal equipment will not be working on the 40-foot benches as stripping is finished in this area. Overburden removal is accomplished before and in front of rock working equipment and is not usually performed in a bench type operation. However, if benches are used, the width would be determined by the kind and type of equipment being used.

2. Drill Pattern

As soon as the quarry location is established and hardness of the rock is determined, a drill pattern should be worked out and followed to get the best breakage of the rock. Oversized rock cannot be sent to the crusher, and extra time and effort is spent in secondary blasting. Drill patterns should remain the same between first and second shift personnel.

3. Loading and Shooting

When the proper drill pattern has been determined and holes have been drilled, loading and shooting can be accomplished. Loading and shooting should be performed during the same day.

Electric delay caps should be used in each hole and delayed to get the most effective fragmentation. The wiring delays should be performed in accordance with the Blasters' Handbook, Edition 14 or 15, for information on explosives, see page 11, Section III.

4. Crusher/Quarry Coordination

The objectives of the crusher and quarry must be carefully planned, since one cannot operate independently of the other. Supervisory personnel must be motivated and aggressive. The quarry supervisor must constantly supervise all drilling, loading, firing, shovel and dozer operations, and coordinate the overall effort. The crusher supervisor will remain at the crusher constantly to ensure all operations are being properly performed to maximize periods of crusher availability - if this is not done, rock production will go down. Another item in efficient quarry operation is the development of a planned maintenance schedule.

5. Utilization of Personnel

When working a two-bench quarry operation, utilize two men per drilling machine and field either four or five crews. The remaining drills and compressors are necessary as backup.

If minimal quarry stripping is required, two D-8s would suffice in lieu of the three stipulated.

III. CRUSHER AND QUARRY EQUIPMENT OPERATION

A. CRUSHER

1. Loading

The most efficient operation comes as a result of keeping the crushing chamber full at all times; that is, up to the level of the top of the jaws. If this level is exceeded, some crushing will occur on the Pitman housing; thereby, causing early failure of the Pitman bearings. The top of the crushing chamber measurement determines the size rock that can be fed into the crusher. Rock should be 2 inches smaller than the top of the chamber.

The shovel operator in the quarry should not load oversize rock to send to the crusher. Oversize rock will cause delay at the crusher. After the oversize rock is dumped onto the pan feeder, the crusher crew will have to lift it off with a hoist. The time spent doing this is production time lost.

Shovel Operation Suggestions:

(a) Keep bucket teeth sharp and built up to proper size
(b) While waiting for trucks move oversize rocks aside
(c) Position shovel so that drive chains are away from the digging
(d) Spot trucks so that they line up with the arc of the swing
(e) Don't swing over truck cab
(f) Work smoothly, slamming and jerking are hard on the machine and operator.

2. Jaws and Rolls

Be positive about the adjustments on the jaws and rolls. The adjustments must be made to produce the end product with the least percentage of recrush.

Keep a close check on the wear of the jaws. Turn the jaws when the bottom half is worn to within 1/16-inch of being smooth. Remove and replace the jaw when both ends have been worn down to 1/16-inch of being smooth. The 1/16-inch applies to any area of the wearing surface, especially in the center. When the jaws are worn out, remove and replace them. The stationary jaw will generally require turning or replacing more often than the movable jaw. Failure to remove or turn jaws when corrugations are worn smooth, will result in premature bearing failure, extra wear, breakage of the toggle place, shaft or base breakage, and therefore, a loss in production.

If a slight movement of the stationary jaw is visible, tighten the key plates. Do not run the crusher with a loose jaw plate.

The frequency of turn or change of the jaw depends entirely upon the abrasive quality of the rock. In places where the rock is not excessively hard, the jaw may last two weeks or more. In other cases where the rock is hard and abrasive, the jaws may need to be turned or changed at a three-to-six-day interval.

3. Toggle Plate

The toggle plate is a safety device for the crusher and will break when

uncrushable material (such as shovel tooth or tramp iron) is fed into the crusher. Toggle plates come in different lengths to compensate for the different openings. Always use the correct toggle plate and make certain that it is properly seated.

4. Tension Springs

Tension springs are installed on the crusher to hold the Pitman assembly tight against the toggle plate. The springs must be kept tight to prevent recoil action, and to keep the plate properly seated. The tension spring must be adjusted when opening of the jaws is changed.

Check all bolts and nuts, flywheels, chain sprockets, and conveyor belts for tightness. The time spent in checking for loose bolts and nuts, can prevent hours or even days of downtime.

During operation of the crusher, the operator should be alert at all times, watching for tramp iron on the belts, loose bolts and nuts, and listening for unusual noises.

5. Operating Schedule

A crusher generally takes much more maintenance than any other piece of construction equipment. Greasing and cleanup of the crusher alone is not adequate to meet the maintenance requirements. The ideal operating schedule is sixteen hours of operation with a thirty-minute greasing period after the first eight hours. The remainder of the twenty-four hour period is to be used to change screens, repair torn belts, rebuild chutes and bins, turn or change jaws, tighten bolts and nuts, or do any other general maintenance required.

CAUTION: Do not use an electric welder on the screens while they are in the shaker box. Do not use an electric welder on the jaws. Do not try to hard-face or rebuild the jaws. The danger of warping the backing place or arcing through the bearings is very great and will cause Pitman bearing failure.

The fact that a crusher needs more maintenance and care than most other construction equipment cannot be over emphasized. If a strict maintenance schedule is not followed, the projected crushed rock production will not be met.

B. QUARRY

1. Drill Operation

When starting a drill hole, the drill steel should be centered by connecting the centralizer arms around the steel. The feed control valve should be opened slowly until the steel touches the ground, and then the rotation valve opened slowly. Until the hole is well collared, feed and rotation air should be light. After the hole is collared, the drill is run with a full throttle on rotation; the centralizers are then unclamped and swung out of the way. If the drill should hit a soft place in the rock, the feed should be slowed to avoid rifling the hole. When the hole is drilled to desired depth, the drill should then be put on full blow to clean the hole.

Oversize rock in the quarry can be used as rip rap on roadways where water is washing the slopes away, or for building causeways.

IV. MAINTENANCE

Performance of repairs to a piece of equipment does not fulfill the requirement for planned maintenance. Repairs should be planned for in advance and performed during period of regular downtime. The rock drills in particular should have a regularly scheduled maintenance program.

A. DRILLS

1. Rotation

If enough drills are available, a rotation schedule should be initiated so that one drill may be in the shop undergoing preventive maintenance at all times. Downtime on drills will be greatly reduced if a schedule is followed. For example: If there are 7 drills in the quarry, six should be working and one should be in the shop. The rotation of drills should be done on a daily basis.

A drill is built of special steels, and is very finely machined throughout. It costs five times as much per pound as a shovel or a dozer, and therefore, should be handled with extreme care.

2. Lubrication

The oil reservoir is built into the track drill and may require filling from two or four times a day, depending on the make and condition of the drill. This oil is forced or sucked into the air stream while the drill is working. The oil mist in the exhaust air gives an indication of the amount being used. The frequency for checking the oil reservoir is best determined by experience. If the exhaust air ceases to carry oil or if too much oil is being exhausted, the cause must be found immediately.

Every possible precaution should be taken to keep the oil clean. This is difficult matter when the air is full of rock dust but it is important. Dirt may clog oil or air passages and score sliding parts.

3. Cleaning

A drill needs periodic cleaning, the interval depending on the quality of air it receives. A bad compressor or a deteriorated air hose may foul it in a day or less. With clean air, it may function well for 10 days or two weeks without cleaning.

A quick field cleanout can be done by disconnecting the air-feed hose and pouring a cup of kerosene of fuel oil into the drill. Reconnect the air hose and run the drill at idle speed for about 90 seconds. Disconnect the air hose once more and pour in one cup of rock drill oil. Reconnect the hose, and the drill is ready for operation. Cleaning may have to be repeated two or three times successively if the drill is extremely dirty. At scheduled times, the drill should be taken to the shop and disassembled, thoroughly cleaned, and worn parts removed and replaced.

B. MAINTENANCE AND OPERATION OF ROLLS

The closest distance between the two roll shell faces should be set at 1/8-inch less than the finished product. For example: If a 1-inch product is desired, the roll faces should be 7/8-inches apart.

The size of the discharge opening is changed by adding or removing shims which spread or close the rolls. Use extreme caution when inserting or removing shims to avoid hand injury. Be certain that each side has the same amount of shims.

The rolls are equipped with shear washers. These washers will break if the springs are compressed to an excess by tramp iron going through the rolls. Several sets of extra shear washers should be kept on hand.

To maintain requirements in the size of rock produced, the parallel faces and outside diameter of the shells must be maintained by periodic welding of the work surface. Care must be exercised to avoid warping of the shells which will hamper the roll shells in seating properly on the spider. Do not cool the rolls by artificial methods such as cold water.

CAUTION: Always ground the electric welder to the shell or spider to avoid arcing through the bearings.

The wearing surface on all chutes and bins should be under observation at all times. As the metal wears off, it should be replaced by welding.

C. PRESTART PM

The air intake on the crusher engines should be secure from leaks and a 40-foot stand pipe installed so that the intake will not take crusher dust into the engine. A prestart PM should be performed at the start of each shift. The sight glass on gear boxes is not to be trusted as it gets clouded and will give a false oil level reading. At the end of each shift, the complete unit should be greased. (At the beginning of a day's run, start the crusher and allow it to run slowly a few minutes before starting feed. At the end of the day's run, stop and feed and allow the material in the crusher to be crushed before shutting off the power.) Keep in mind that it takes less time and effort to grease the machine than it does to tear down and change parts. Grease is cheaper than parts.

D. LUBRICANTS

If foreign substances such as dirt, dust, abrasives, etc., are allowed to enter the housings of a bearing, premature failure will occur. When greasing Pitman Bearings and side bearings, the grease must show at the seals to make an effective dust seal. Put grease in these bearings with a pressure gun.

V. SAFETY

A. PACKING AND UNPACKING

Dynamite may be packed in cardboard cases or wood boxes. The cardboard case may be readily torn open, but the wooden box presents a special problem.

The wood box should be opened by knocking the top off with a wooden wedge and a hammer to avoid sparks from metal tools, however, the top can be pried off with a screwdriver or a pinchbar with very slight danger.

Care should be taken to get the tools between the nails rather than against them to prevent their being pushed into the dynamite.

CAUTION: The wood or cardboard from opened boxes may be explosive from fragments of dynamite sticking to them or from the liquid of decomposing dynamite soaking into them. They are, therefore, unsafe for further use, and should not be burned in close proximity to personnel or buildings.

B. SPECIAL PRECAUTIONS

Dynamite may cause severe headaches. This is especially apt to occur if it is unwrapped and handled with bare hands. Different brands and strengths differ in headache producing qualities and individual reaction is highly variable. Persons handling explosives should not smoke and preferably carry no matches. A complete list of safety precautions will be found in each box of dynamite. A few basic rules may be emphasized here:

1. Do not expose explosives to flame, heat, sparks, or electric current, shock or friction, and do not load or handle during a thunder storm. Do not use short wave radio in the vicinity while loading holes.

2. Do not use iron tools.

3. Keep caps and powder separate.

4. Keep a record of explosives used on the job, and the amount used in each shot. Make sure no unexploded material is left lying around in the quarry.

In a general way, it may be said that one pound of 40 percent dynamite will move 1 yard of hard rock.

VI. SUMMARY OF BASIC FUNDAMENTALS IN QUARRY/CRUSHER OPERATION

QUARRY LOCATION, OPERATION AND MAINTENANCE

1. Locate close to where product will be used.

2. Locate close to crusher to minimize road building and maintenance, and overburden removal.

3. Locate a safe distance from crusher for protection from flying rock fragments.

4. Locate as close as possible to a waste site.

5. Keep oversized rock clear of area either by blasting or removing with cat.

6. Quarry should be opened with a long operation in mind.

7. Shovel operators should take care not to send oversize rock to crusher.

8. Personnel must be trained for operation of track drills.

9. Keep haul road smooth and clear.

10. Maintain the depth of drill holes at 20 feet.

11. Keep benches squared off and neat.

12. Benches should be at least 40 feet wide or wide enough for the easy maneuvering of the shovel or cat.

CRUSHER INSTALLATION, OPERATION AND MAINTENANCE

1. Choose a level and stable foundation for installation of crusher.

2. Conserve space.

3. Locate crusher for easy availability for servicing.

4. Secure leaks on air intakes on both diesel engines.

5. Check engine oil and water.

6. Check all gear boxes.

7. Lubricate all places specified in the operator's manual with proper lubricant.

8. Check adjustments on all clutches.

9. Check the wear on jaws, and the changing of jaws.

10. Check the wear on rolls, and the welding on rolls.

11. Change screens as required.

12. Continue general maintenance of the crusher during and after operation.

SAFETY

1. Use electric delay caps to get good fragmentation.

2. Use only well-trained personnel in the handling of explosives, with special training in the fragmentation of rock.

APPENDIX REFERENCES

A. Moving the Earth, second edition, by H. L. Nichols

B. COMCBPAC Instruction 11200.20A

C. Pits and Quarries TM5-332

D. Blasters' Handbook, E. I. Dupont De Nemours Company

Table 7. Crusher Staffing Requirements

Staffing and Equipment	Day Shift	Night Shift
Supervisor	1 EO1	1 EO1
200-ton Primary	1 EO1	1 EO2
- - - - - - -	1 EO3	1 EO3
200-ton Secondary	1 EO2	1 EO2
- - - - - - -	1 EO3	1 EO3
- - - - - - -	1 CN	1 CN
Screening Plant	1 EO3	1 EO3
4 Conveyors	- -	- -
1 Welding Machine (600 AMP)	1 SW2	1 SW2
1 Cherry Picker	- -	- -
1 Front-End Loader (2CY)	- -	- -
1 D-7 or TD-20	1 EO2	1 EO2
1 Light Plant		
3 100 KW Generators		

Tools

Welders Kit
Electricians Kit
Hard Facing Machine
Hand Labor Tools

NOTES: (1) If the shop area is located an excessive distance from the crusher site, add one CM2 at the crusher site.

(2) A 200-ton/hour crusher will require an excess of 100 KW hence, two 100 KW generators are set up in parallel. One additional 100 KW generator is designated as backup.

(3) Consideration should be given to setting up a welding shop at the crusher site to handle hard facing for both the crusher and the quarry.

Table 8. Shop Staffing Requirements

Staffing and Equipment	Day Shift	Night Shift
Supervision	1 CMC	- - -
Mechanics	1 MR1	1 MR2
- - - - - - -	1 CM1	1 CM1
- - - - - - -	3 CM2	- - -
- - - - - - -	7 CM3	- - -
- - - - - - -	1 SW2	- - -
1 Water Truck	1 EO3	1 EO3
1 Fuel Truck	1 EO3	1 EO3
1 Lub/Field Truck	1 CM2	1 CM2
- - - - - - -	1 CN	1 CN
3 Water Buffaloes (500 Gal ea)		
2 1-inch or 2-inch pumps		
1 3-inch pump		
1 Machine Shop Trailer (with welding machine)		
1 Forklift		

Tools

3 Heavy-duty Mechanics Kits
3 Mechanics Kits
1 Welders Kit
1 Set Heavy-Duty Sockets

NOTE: Mechanic staffing obtained utilizing a 3-to-1 equipment to mechanic ratio.

APPENDIX B

MCB CAMPS AND LAYOUTS

TABLE OF CONTENTS

The following will serve to summarize the desirable/undesirable features of Seabee Camps.

I. DESIRABLE FEATURES

A. CAMP CAMPBELL

1. The shop spaces and equipment are excellent.

2. A large, well drained equipment yard is available.

3. The camp contains an excellently equipped timber prefab yard.

4. Adequate clubs for all groups except Chief Petty Officers are available.

5. A large project material storage yard is available.

B. CAMP ADENIR

1. Small camp size allows the area to be defended by a minimum number of security personnel.

2. Efficiently laid out supply area with room to house all functions (Supply, Disbursing, MLO, CTR, Greens Issue, etc.)

C. CAMP BARNES

1. CTR and MLO are located within easy walking distance from all company offices. This provides easy access to tools and materials.

2. All shop spaces are located in close proximity to the company offices.

3. The camp dispersal is such that casualties will be minimized in the event of rocket, mortar or artillery attack.

4. Company integrity is maximized by placing officer and CPO living quarters in their respective company living areas.

D. CAMP WILKINSON

1. Centralized location of all administrative and company offices is adequate.

2. Adequate large camp area for storage.

E. CAMP RHODES

1. Company shops are well removed from the living areas thus providing noise abatement and settling of dust raised by vehicular traffic.

2. Administrative area is conveniently located providing close communications between the staff offices.

3. The CO's hut is conveniently located near the CP bunker.

F. CAMP HASKINS SOUTH

1. Battalion administrative and galley area are centrally located thus making them readily accessible to all personnel.

2. The perimeter berthing hut alignment is preferred as this allows the camp perimeter defenses to be manned faster with less confusion.

3. HQ, Alpha and Delta Company personnel are berthed in the immedate proximity of their perimeter security assignments.

4. The camp utilizes one pre-cut and one pre-cast yard, operated by Charlie Company and Delta Company respectively. This has proved highly satisfactory, and one central location for each of these operations is considered superior to each company performing both tasks in small areas by themselves.

G. CAMP HASKINS NORTH

1. Camp is divided into functional areas in an organized manner.

2. Location of berthing areas, galley, service areas, recreation facilities, shops, administration offices and transportation equipment areas are such that they compliment rather than interfere with the operation of each function.

H. CAMP HOOVER

1. Arrangement of camp facilities has proven workable and is generally satisfactory for most of the major camp functions.

I. CAMP HAINES

1. Functional areas (berthing, administration, supply, etc) are located on hills to take advantage of adequate terrain drainage.

2. The administration area was laid out in circles, thus allowing for easy communication within the area but still setting it apart from the rest of the camp while leaving it centrally located.

3. The berthing areas were laid out in circles, one for each company, the officers and the CPOs, with two allocated for Alpha Company. This allows company areas of responsibility to be easily discernable.

4. Showers are centrally located in the berthing circles for easy access.

5. Due to circular layout, it is not easy to walk incoming rounds through a row of huts.

6. Ground cover, grass, brush, and trees were left intact, adding to the pleasing appearance of the camp and cutting down on necessary drainage structures, mud and dust problems.

J. CAMP SHIELDS

1. Camp location is very desirable as 3 sides of camp are protected by military units and the 4th side is beach, this minimizes the perimeter security problem. Also the climate is good due to camp seaside location.

2. Camp physical layout and facilities are adequate. Berthing areas are located near recreation areas, service facilities (laundry, exchange, barber shop, etc) and EM mess.

3. The facilities are superior to that of other camps and has contributed to the high morale of the men. The camp has a softball field, basketball court, swimming beach, hobby shop, tape and photo lab, volleyball courts, EM Club (newly redecorated) and a fine library.

4. Camp Shields also has an independent and adequate water source.

II. UNDESIRABLE FEATURES

A. CAMP CAMPBELL

1. Officer and enlisted berthing huts are located too close to Alpha Company and Bravo Company Shops. The noise level is too great.

2. The CP is too far away from the CO hut.

3. Inadequate drainage. Random arrangement of drainage ditches throughout camp.

4. Berthing huts are scattered helter-skelter about the hillsides.

5. Too large a camp combat perimeter (over 1400 meters).

B. CAMP ADENIR

1. Camp is too small and is overcrowded.

2. No water plan for camp layout.

3. Showers not conveniently located.

4. Most huts have 4' sidewalls. Berthing huts should have 6' minimum sidewalls.

5. Poor drainage and culverts fill up with sand during run-off from rains.

6. Precut and prefab area should be near Delta Company and Charlie Company Offices.

7. Inadequate electrical power to precut/prefab yards.

8. Traffic doesn't pass the Alpha Company dispatch shack.

9. Sand bags are inadequate.

C. CAMP BARNES

1. Distance between Administration and shop area is excessive.

2. Concrete batch plant and pre-cast yards are located too far away from Charlie and Delta Company.

3. Location of helicopter pad near the mess hall accentuates the dust problem.

D. CAMP WILKINSON

1. Camp location is on a too severe sloped area causing excessive erosion and dangerous walking conditions.

2. The soil is sterile, shubbery and grass will not grow.

3. The galley is not properly located. (In a gulley causing water problems in the rainy season.)

4. Nearby 8" gun battery fires directly over base.

5. EM quarters are grouped too closely for safety in a combat zone and are overcrowded.

E. CAMP RHODES

1. Not enough showers and heads in the enlisted berthing area.

2. Main entrance road should not go through the berthing area.

3. Alternate CP is inconveniently located for the XO.

F. CAMP HASKINS SOUTH

1. All major drainage ditches are not lined with concrete.

2. Material project yard is too small.

3. Camp power distribution system is inadequate, very limited emergency power.

G. CAMP HASKINS NORTH

1. The random orientation and layout complicates installation and maintenance of utilities.

2. Camp layout does not lend itself to growth expansion of service areas and utilities.

3. Random camp perimeter is undesirable and should be straight to minimize the possibility of shooting friendly forces during attack. A perimeter road would be an asset.

4. Not enough physical separation between officers, CPO and E-6, and below enlisted areas to allow for more privacy for senior personnel.

5. Shortage of lavatory and shower facilities.

6. No growth potential in facilities and utilities loading in the design of galleys, Bravo Co. Shops and Alpha Co. Shops.

7. Emergency back-up power is inadequate (200 KW) when 400 KW is required. Not desirable to rely on commercial power.

8. Camp waste disposal is a problem due to random disposal.

9. Heat packs provided for galley, laundry, showers are unreliable and dangerous to operate.

10. No means to load share power requirements to critical areas when on reduced power.

11. Do not have elevated storage tanks of 500 bbl minimum capacity.

12. Sandbags for bunkers and fighting holes are undesirable. Cost and manpower of these items is prohibitive.

H. CAMP HOOVER

1. ASP #1 located too close to main camp.

2. Berthing huts are too closely spaced.

3. No outdoor activities located near berthing huts.

I. CAMP HAINES

1. Security perimeter is large due to dispersed camp layout.

2. Berthing areas are too close to perimeter. Officers berthing is too far away from the Administration Area and CP.

J. CAMP SHIELDS

1. Lack of useable real estate. All functions are crowded together and there is no place to expand. Shops, supply, construction material and equipment yards are congested. Berthing area is crowded and is inadequate to house a full battalion comfortably. Berthing huts are too close together and should be located closer to fighting positions.

2. Lack of planned drainage areas around shops, especially equipment shops should be either soil cemented, asphalted or matted.

III. CAMP LAYOUTS

SEE THE FOLLOWING PAGES FOR INDIVIDUAL CAMP LAYOUTS.