Engineering Operations on Advanced Bases

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In all the theaters of operations on our far-flung battle lines, enemy forces are being driven back and new bases are being established for our front-line forces. Many problems arise in developing these bases. Some of the problems are more or less common to all advance bases, while others are peculiar to particular locations and conditions. Many different methods, some better than others, are used to solve common problems. The detailed knowledge of how particular problems have been solved in certain bases is often of great value to officials in other bases. This article, covering engineering problems encountered in some forward Southwest Pacific bases, is written in an attempt to pass on some useful information and also to encourage discussions on this vital subject

Advance Planning

The importance of advance planning for a new base cannot be stressed too highly. This planning should be started prior to actual landing operations. A skeleton staff, made up of officers from each major branch of the service, should take part in this planning. Every available means should be used to obtain as much knowledge as possible about the new base. One of the best methods of doing this is to study aerial photographs of the area by means of a stereoscope.* A large-scale planimetric map is a great aid in co-ordinating this advance planning and very useful to the tactical troops both prior to and after the landing has been made. If a suitable map is not available, a reasonably accurate map can be quickly made from aerial photographs by using the radial-line method where the map is made to the average scale of the first two photographs. (See Par. 78e, TM 5-230.) Tentative locations for airdromes, roads, wharves, telephone lines, bivouac and storage areas, hospitals, et cetera, can be spotted on this map.

The recommended scale for this map is 1:7,200 or 1 inch = 600 feet as this is the most practical scale for the general purpose use of the aerial photographs from which it is made. Distances can be readily scaled by using the 60 scale on the Engineer's scale. Having photographs taken periodically in this uniform scale makes plotting of construction progress on the map very easy and reduces materially the extensive field surveys normally used for this purpose.

Planning After Landing Has Been Made

During, and immediately after, the initial landing operations, the tactical situation predominates, and roads for supplying the combat troops should receive first consideration. With proper advance planning these roads can be located so as to fit in with the final plan for the base. As the enemy is driven back, thorough ground reconnaissance should be made as a check on the tentative advance plan for the base. Use of aerial photographs is of great assistance in this reconnaissance.

Normally, the first actual base construction will be airdromes for the Air Corps and most of the heavy construction equipment will be needed for this purpose. Our own tactical roads and former enemy roads will have to be put to maximum use as, initially, very little equipment will be available for this type of construction. However, the use of a few pieces of equipment for building permanent, well-located roads will usually pay big dividends, and often these roads can be built with less equipment than would be required to maintain the poor roads properly. Also, in early operations, the supply of all types of transportation and spare parts for repair are always at a premium, so damage to this equipment due to poor roads should be reduced to a minimum. *Provision for proper drainage is of major importance. Plans for this drainage should be made before construction starts and should be continually kept in mind throughout the life of the base.* Sufficient, competent staff inspectors should be in the field contantly, at night as well as during the daytime, to supervise construction. It is desirable that the primary features which should be covered in such inspections be well defined, in order to insure that consideration be given, by the appropriate technical staffs, to the principal factors effecting efficient prosecution of construction operations under their supervisory control. These inspectors should insure that proper construction methods are employed on these specific projects. For example, they should check such things as unbalanced effort in the use of man-power and equipment. Every effort should be made to eliminate bottlenecks. In the early stages, Engineer troops will be at a premium, so the main objective should be the efficient planning, supervision, and coordination of these units to attain the maximum of results quickly by the minimum of overall engineer effort.

Another vital problem in the early stages of any operation is the lack of ships to transport needed supplies and the lack of facilities to unload ships when they do arrive. Supplies for the tactical troops, both ground and Air Corps, generally receive first consideration. There is always a scarcity of lumber and other supplies for engineering construction. Every effort should be made to put sawmills into operation promptly in order to correct this situation. Where possible, native poles should be utilized in constructing buildings for operational offices, mess halls, and covered storage. Troops should remain quartered in tents until such time as essential construction is completed.

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Details of Planning and Construction

The stereoscopic examination of aerial photographs will be found to be one of the most useful tools for planning all types of construction. There are certain fundamental principles in construction, which if followed, will lend to the efficient operation of the base. A brief description of the application of these fundamental principles to the various base construction projects are as follows:

Airdromes—The planning of airdromes is too complicated a subject to cover in this article. Adequate information on it is given in various War Department publications. However, it is desired to call attention to the great assistance that aerial photographs will give in suitable sites. Runways, parallel taxiways, and hardstands can be laid out on these photographs by stereoscopic study and the photographs can then be taken into the field and the photo location placed on the ground. A good method to use in these studies is to use pieces of transparent acetate cut to the proper size for the scale of the photograph to represent the runway, hardstanding or other features, the location of which is being studied. The best ground location for the features can be determined by shifting these transparent models on one photograph of an overlapping pair while the stereoscopic study is being made.

Roads—For the efficient operation of a base, roads, wherever possible, should be built as a series of straight tangents connected by easy curves. With the prevalent heavy volume of traffic and bad dust conditions, crooked roads slow up operations and cause many accidents. For example, the right angle turn and the bridge shown in Figure 1 were the cause of a number of accidents resulting in many injuries and one fatality. The location of this road was eventually changed as indicated, after which no more accidents occurred there. If the available photographs had been used initially in locating this road, most of these accidents and considerable unnecessary road construction would have been avoided.

Where roads are built in areas of frequent rains, it is absolutely necessary to provide a fully-crowned cross section and to have adequate drainage. Soil stabilization is especially important in road building; by its use a firm, usable road can usually be built by the proper mixture of materials found along the road right-of-way, thus saving the time and equipment which would be consumed by the hauling of road-surfacing material from distant points. An experienced, practical man who can dig a few test holes, feel the soil and then prescribe how much of each soil is to be used in building each particular stretch of the road is invaluable for this type of work. Periodic sieve analyses and laboratory tests should be made of the various types of soil on the base in order to determine what mixture of available soils will give the best results. However, usually such a wide variation in soil conditions will be found that use of such tests for each little stretch of road or airdrome will be found too time-consuming to be practical. It is far better to have a man who by feeling and looking at soil can prescribe the proper mixture to use. An experienced civilian from the Australian Public Roads Department, who was employed in an advisory capacity at several bases, proved to be invaluable for this type of work.

Wharves

Normally, the first semi-permanent docks installed at any base are D-type docks, 30 feet wide, built to serve one Liberty Ship. Comprehensive plans should be made for eventual dock expansion so that when individual Liberty Docks are connected up to form a continuous dock extra construction required to secure a straight face for the dock will be avoided. A Phase-2 dock is one whose width is expanded from 30 feet to 70 feet. A Phase-2 and -3 dock is one in which the space between approached to the Phase-2 dock are filled in so that trucks can be backed up to the back face of the dock. A Phase-2 and -3 dock can handle a third more freight with the same men and equipment than can a Phase-1 dock; hence, original wharf construction plans should provide for eventual extension to this type of dock. Figure 2, page 17 shows the work in progress on extending a Phase-1 dock to form a Phase-2 dock.

If possible one or more large transshipment warehouses should be built close to the docks so that fork lifts can transport cargo directly from the ships to the warehouses and vice versa. All large depots and storage areas should be located as close to the docks as possible. The desirability of such locations becomes especially apparent when bases begin to disband and there is a scarcity of both labor and motor transportation. This procedure consolidates the base, thus permitting available labor and transportation to be shifted quickly to points where they are most needed.

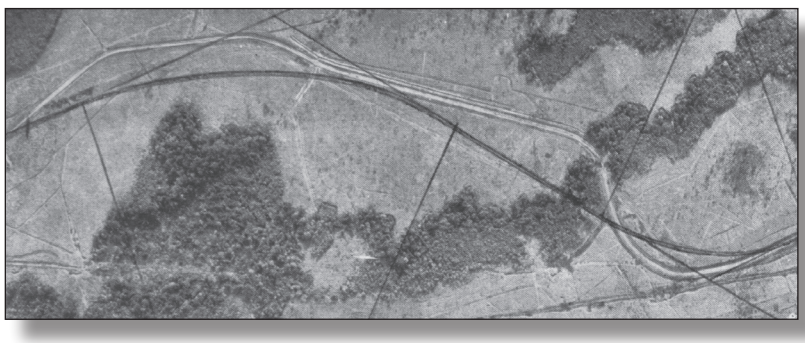

Figure 1. Relocation of Road to Eliminate Hazards

Water Supply

Experience has shown that, where possible, a central water-supply system should be built at the earliest possible date to serve the main base installations. Such systems can usually be installed quickly by using Avgas tanks and 4-inch Avgas pipeline. At some bases, a great deal of material, time, and labor has been used in providing small individual water points whose inadequacy eventually required that a central

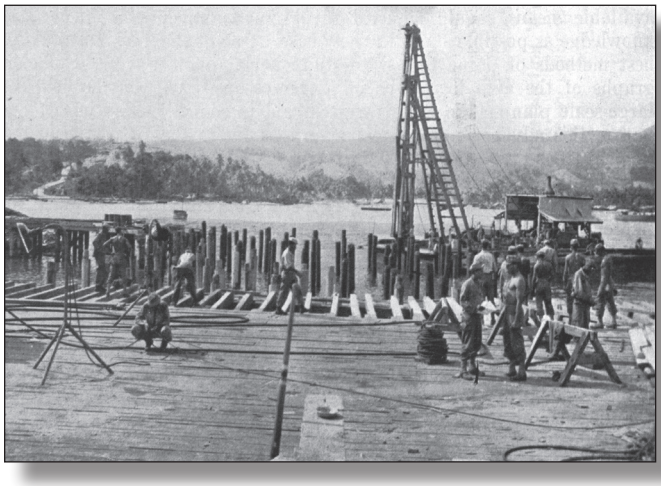

Figure 2. Extending Dock to Phase-2 Type

system be built. One of the main considerations in planning such a system is to provide water for ships at the docks. If possible, the source of water should be located so that water can be supplied by gravity rather than by means of extensive pumping operations. Pumps are generally both hard to obtain and to maintain and a sizable crew is needed to keep them in operation.

Bridges

Where tropical deluges, causing flash floods carrying much debris, are prevalent, bridges should be built with as wide span and as much clearance as possible. In one case, such a debris jam wrecked the existing bridge and changed the course of the river so that it endangered extensive base installations farther on downstream. This danger was relieved by blasting out a new channel in order to move the river back to a satisfactory location.

Most of the bridges in the Southwest Pacific Area bases have been of pile bent construction and much trouble has been caused by flash floods washing out the abutments of these bridges. The remedy for this situation has been to drive the end pile bents at points as far up the bank slopes as possible and use an extra stringer span at each end. Experience has shown that by building these bridges with a floor elevation 2 feet above the level of the roadway and using the stringer spans as ramps, traffic is slowed down and damage to bridges due to impact is materially reduced.

Covered Storage

When a base is first started some covered storage must be provided immediately as protection for perishable and critical items. Since, normally, lumber and other construction materials are not available at these early stages, the common practice has been to construct buildings 20 feet wide of native poles and to using tarpaulins for roofing (see Figure 3). It has been found that, in this type of construction, buildings 40 feet wide can be constructed almost as quickly as the 20-foot buildings and one such building gave more storage space and better protection than did two 20-foot buildings. Neither of these two types of buildings is satisfactory for efficient base operation. Where possible, storage sheds with concrete floors, so that supplies can be stacked and handled by means of fork lifts, should be constructed at the earliest possible date (see Figure 4).

Figure 4. Prefabricated Storage Shed with Concrete Floor

A good plan to secure quick temporary coverage is to use tarpaulins over individual rafters which are placed on the top of carefully piled stacks of supplies as illustrated in Figure 5, page 18.

Figure 3. Storage Sheds, 20 Feet Wide, of Native Pole Construction

Staging and Training Areas

Plans should be made to locate staging areas so that adequate training areas are easily accessible. Also, staging of units will be greatly facilitated if the areas are laid out to accommodate standard-sized units, and if housekeeping facilities, such as headquarters buildings, mess halls, water tanks, storage buildings, latrines, and shower baths are built before the unit arrives. The buildings need be only native pole frames that can be covered by the units' own tarpaulins.

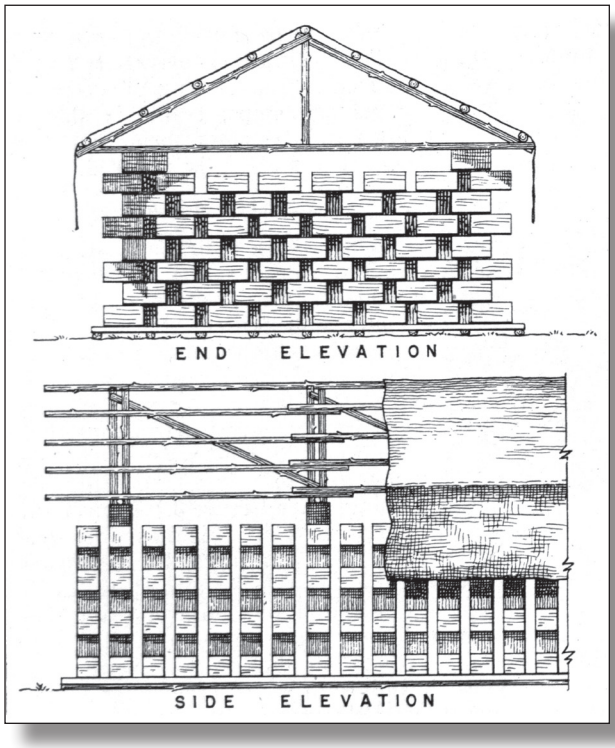

Figure 5. Improvised Cover for Stacked Supplies

Miscellaneous Base Facilities

Much improvisation is needed in order to provide the various facilities that are required for base operations. Frontispiece shows how salvaged oil drums used as a retaining wall and engineer heavy equipment were employed to prepare a foundation for a concrete loading dock to be used by the Quartermaster for distributing Class 1 supplies. Figure 6 shows the construction for the water supply of a WAC camp. A clamshell bucket was first used to dig a large hole for the well, later to lower a strongly built lined framework into this hole and, finally, to backfill the loose sand around this frame. This was a much quicker operation than the normal method of sinking a shaft. Note the native poles used as columns for the water tower structure. A church was also built by using native poles and a canvas tarpaulin for a roof.

Figure 6. Water-Supply System for a WAC Camp

A base carpenter shop equipped with power, cross-cut, and rip saws and other labor-saving devices is an essential base facility. It can be used day and night for making furniture, packing crates, boards for signs, mess tables, benches for theaters and churches, and framing for all types of portable buildings, et cetera. A sign-painting shop, electrical equipment-repair shop, and a combined water-supply and plumbing shop are also essential.

This whole discussion has been based on the situation where our air power has been so superior to that of the enemy that danger from enemy bombing has been very slight. Where danger from bombing is great, provisions will, of course, have to be made for dispersal of activities and utilization of natural cover for camouflage wherever possible.

Conclusion

The Engineering considerations needed to insure the success of forward base operations are:

1. Careful advance planning.

2. Thorough knowledge of terrain secured by personal reconnaissance and by stereoscopic study of aerial photographs.

3. Properly located and constructed base facilities such as airdromes, roads, wharves, bridges, water-supply installations, storage facilities, staging areas, et cetera.

4. A comprehensive, continually followed up plan for drainage.

5. An adequate and qualified engineer supervisory staff making day and night inspections of essential construction and maintenance work.

6. Knowledge of the overall needs of all branches of the Service, and continuous contact with these Services, to understand and plan in advance to meet changing situations.

7. Consolidation of base facilities so as to have economy of time, space, and effort. This is especially important in the closing up stages of a base when there is a scarcity of labor including prisoners, natives, and casual labor so that the withdrawal of engineer troops to new forward bases will not disrupt operations.

*See "Use of Aerial Photographs," by Colonel Albert L. Lane, in *The Military Engineer*, July, 1943.

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