CHAPTER 4

LANDING ZONE, REMOTE SITE AND CONSTRUCTION CLEARING

Section 1. LANDING ZONE AND REMOTE SITE CLEARING

4-1. Landing Zone Clearing

a. General. Landing zone (LZ) clearing is necessary to support airmobile operations in forested areas. Initially it may be only a one-helicopter LZ cleared from the jungle using demolitions and chain saws, but it can be developed into a large combat base in successive stages. When an infantry battalion is conducting an airmobile combat assault into a heavily forested area, the engineer platoon is often the first airlift into the landing zone, depending on whether or not security is already on the ground. Their mission is to initially clear the landing zone to allow one helicopter to land and then to bring in more equipment to improve and expand the landing zone.

b. Landing Zone Cutting Team.

(1) If an initial clear area is available, an engineer landing zone cutting team can establish an LZ by descending into the site with its jungle cutting equipment from a hovering Chinook (CH-47) helicopter (fig 4-1), after the area has been secured by ground forces. This team must be extremely well trained and each mission well planned. A reconnaissance of the proposed LZ should be made by an engineer officer or NCO if time permits. As a result of this reconnaissance, the tools and equipment necessary to be taken to the LZ may be selected in order to provide the best tools for the specific type of vegetation to be cut. For example, bamboo is most effectively leveled with bangalore torpedoes. Typical items of equipment taken into the LZ are ammunition, machetes, brush hooks, chain saws, two-man crosscut saws, axes, potable water, C-rations, premixed gasoline for chain saws, oil for chain saw lubrication, demolition bags, C-4 plastic explosive, bangalor torpedoes, detonating cord, sharpening equipment for tools, mechanics tools for chain saw repair, and chain saw repair parts. This equipment is prepacked in two sling loads, and a third load for resupply containing additional explosives is prepacked for on-call delivery. Immediately upon arrival at the mission site, the team leader coordinates with the tactical commander on the ground to establish work priorities and to explain demolition safety and procedures.

(2) A second method of inserting a platoon or squad sized engineer landing zone cutting team into an area is by rappelling from a hovering utility or troop carrier. The team must have had prior training in rappelling practice in actually using helicopters. The rappel from the helicopter is made using a rope, and a "Swiss" seat- **O** -ring arrangement. Gloves are worn to avoid rope burns and only essential equipment is taken on the initial insertion. This consists of weapons and ammunition, chain saws, demolition bags, C-4 plastic, explosive, machetes, premixed gasoline, oil, C-rations, and water. After a one-s hip LZ has been cut, more equipment and men are inserted. There must always be close coordination between the team leader, the helicopter pilot, the pilots of any gunships accompanying the mission, and the ground security forces. In comparing this method of insertion with the method using a Chinook (CH-47) and a rope ladder there are certain advantages. The insertion by rappel is a faster method and gets the team on the ground faster. This is important when rappelling under hostile fire into a "hot" LZ. Also, there is less chance of single ropes getting entangled in trees as compared to a rope ladder. This becomes significant when establishing an LZ in double or triple canopy jungle or very thick forest. The advantage of using the Chinook is that it can carry more troops on a single sortie.

Figure 4-1. Combat engineer landing zone clearing team descending from a hovering Chinook (CH47).

c. Demolition Techniques. Demolitions used in landing zone clearing are C-4, TNT, detonating cord, and bangalore torpedoes. The C-4 and detonating cord are used for felling trees and are the two items that account for the bulk of the demolitions. When C-4 is not available, TNT is an acceptable, yet less desirable, substitute. Because external charges are used, the approximate weight of C-4 is only 70 percent of the weight of TNT required to accomplish the same task, so there is less to transport. Also, C-4 is faster and easier to place than TNT and can be molded around trees for more effective results. Charges are placed approximetely 4 to 5 feet above the ground where the tree has thinned down to the nominal diameter and not at the tapered root section or buttress. The remaining stumps are removed or cut down with chain saws or other techniques where their presence will interfere with intended usage or expansion of the LZ. In dense forest, up to 100 trees are prepared at one time and are detonated simultaneously using a detonating cord ring main. Nonelectric caps are preferred over electric caps to eliminate the potential hazard of radio signals detonating an electric cap prematurely. However, if helicopters are resupplying an LZ while it is still being expanded and improved, the explosives create a precarious situation for the incoming helicopters. Even with good communications there are often problems. For this reason electric caps may be preferred because the exact instant of detonation can be controlled using electric caps and a blasting machine. The quantity of C-4 and detonating cord required for clearing a landing zone varies with the type and density of vegetation and with the size of the area required. A "rule-of-thumb" which relates the number of pounds of C-4 to feet of detonating cord has been developed. For dense vegetation (triple canopy, average tree diameter between 12 and 36 inches), 1 foot of cord is required per pound of explosive; for light vegetation, 2 feet of cord per pound of explosive. Bangalore torpedoes are used extensively to clear dense bamboo growth. The shrapnel from the torpedo casing is extremely effective in leveling bamboo with stalk diameters up to 6 inches. The pattern used is to place bangalore torpedoes in parallel lines spaced at 10-foot intervals throughout the area of bamboo.

d. Employment of Large Clearing Munitions. One effective innovation for the crest ion of helicopter landing zones (HLZ) has been the use of large aerially delivered munitions to knock down trees and other vegetation and thereby create an initial opening suitable for creating a landing zone for use by helicopters. The technique of using a single large conventional explosive charge for clearing HLZ in dense forested areas has been found to be highly satisfactory.

(1) Landing zones may be classified according to the ability of a given helicopter to utilize the site. Full touch zones (FTZ) permit a complete landing, skid touch zones (STZ) require that the helicopter support most of its weight by the rotor, and non-touch zones (NTZ) allow no more than a hover. Because of the uncertainty associated with the initial size and postblowdown condition of the clearing, all "bombed" sites should be tentatively classified for planning purposes as nontouch zones.

(2) An M121 (T56E4) concussion-type bomb of 3.6 metric tons (10,000 lb) explosive charge was used previously during tests. Another weapon of 6.6 metric tons (15,000) is presently available and one of 4.5 metric tons. (12, 195 lb) is under development. The M 12 l-type has been dropped from C-130 and CH-54 aircraft; a good view of the assembly may be seen in figure 4-2. A fuse extender mounted on the bomb nose is designed to detonate the munition about one meter above ground, thereby achieving maximum vegetation blowdown while minimizing undesirable soil cratering. A stabilizing parachute, tail fuse, and metal shroud placed around the tip of the fuse extender are designed to insure that the bomb penetrates the vegetative canopy and detonates as planned.

Fig 4-2. CH-54 with M121 clearing munition en route to target.

(3) Soil cratering effects appear to be nominal. At one test site the maximum depth and diameter were approximately 64 centimeters and 14 meters, respectively; but beyond about 5 meters from ground zero (GZ) cratering was insignificant. At another test site cratering was also nonexistent or insignificant. Consequently, soil cratering has been assumed to be of no consequence to helicopter operations when these large munitions are employed.

New fusing procedures also help by initiating detonation from both ends of the explosive charge, thereby minimizing cratering effects while maximizing blowdown forces exerted outward.

(4) Tree blowdown is characterized by the upper portion of the tree generally being separated and carried away from the lower portion by the shock wave. The break is seldom clean and wood splinters protrude above and below the point where failure begins. In the area within a 5 meter radius of ground zero tree failure occurs close to the roots. The stems and crowns of the trees are destroyed and carried out of the area by the blast, giving the ground a clean appearance. At greater distances, out to a radius of about 25 meters, lass vegetation is removed. Tree failure occurs at greater heights, producing taller remnants. Also, debris (branches, leaves) accumulates on the ground between the remnamts, producing a littered appearance. Thus, stump height increases with increasing distance from ground zero. and the amount of debris littering the ground increases also. Experience with air-delivered clearing munitions indicates that engineer troops must often enlarge and clean up this blowdown area to make it fully usable for helicopter operations.

(5) Figure 4-3 shows an aerial view of the clearing effects produced in a test which may help the reader visualize the effects of clearing munitions on forested areas. This test detonation produced almost total removal of vegetation out to a distance of 10 to 20 meters from GZ and significant damage up to distances of 40 to 60 meters. Table 4-1 presents some of the limited results available from tests which were conducted.

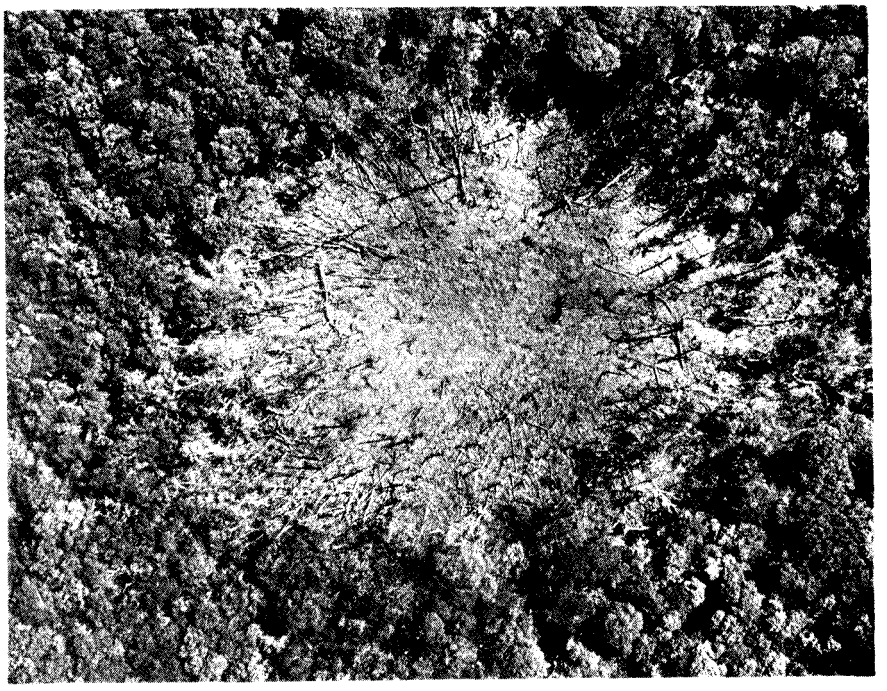

Figure 4-3. Aerial view of test site.

Table 4-1. Tree Remnant Heights for Test Detonation of M121 Munition (3.6 metric ton TNT yield)

Site No.	Local topographic slope (degrees)	Min radius, in m, of area cleared of obstacles 0.3 m	2 m	4 m	Maximum approach angle (degrees)	Category of HLZ constructed
FB-01	1	5	11	12.5	37	FTZ
SVN-01	9	11	23	25.0	32	FTZ
SVN-02	37	7	9	≥ 9.0	(*)	None
SVN-03	45	11	14	≥14.0	(*)	None
SNV-04	6	11	17	27.5	44	FTZ
SVN-05	9	0	11	14.0	(*)	NTZ
SVN-06	15	(**)	(**)	(**)	(*)	None
SVN-07	7	(**)	(**)	(**)	(*)	None
SVN-08	11	10	24	≥ 24.0	(*)	STZ

* No data, but the maximum approach angle in all cases was less than 75 deg.

* * .Large boulders and / or tree remnants ranging from 3 to 8 m in height were present at or near GZ.

(6) It is clear that several munitions might be employed to create a larger HLZ capable of accommodating several aircraft or of improving the approach and departure zones for one site. In such cases, these devices should be detonated no more than 24 meters apart. Accurate placement becomes essential and may not be attainable by drops similar to the past operational tests where CH-54 and C-130. aircraft flew at altitudes 1850 meters or higher above the terrain and at relatively high air speeds.

e. Chain Saws. Chain saws are used for cutting down standing timber up to 16 inches in diameter, but the major portion of their job in clearing a landing zone is to cut timber previously felled by demolitions. Fallen timber is sawed into lengths which permit manual clearing of the area. Timber may also be cut into lengths for later use in field fortifications, gun pads, or other facilities in the LZ. Chain saws are totally ineffective in cutting bamboo. The pulp clogs the chain assembly and it must be disassembled and cleared after only one cut. Shrapnel from preparation fires causes chain saw maintenance problems because hidden pieces of steel cause broken and dull chains.

4-2. Fire Support Base Clearing

a. General. Often in the sequence of an airmobile operation, a landing zone is developed into a fire support base (FSB) by enlarging it to accept the unit's mortars and eventually support artillery.

b. Layout and Planning. The siting of the heaviest artillery should be given first priority in the layout of an FSB. It must be reasonably level and free of stumps, and require a minimum of clearing in the principal direction of fire. The engineer should coordinate closely with the artillery commander because often a small shift in gun positions can significantly increase or decrease the amount of clearing required to eliminate the tree mask. The engineer should be prepared to build and assist in building overhead cover and bunkers for all personnel, ammunition, and equipment on the fire support base. The same equipment as used to cut an LZ should be taken as well as shaped and cratering charges to blow holes for underground bunkers.

c. *Airborne Equipment.* Clearing an FSB in a heavily forested area at a site inaccessible by surface movement using manual techniques is difficult and slow. When available, lightweight sectionalized airmobile crawler tractors equipped with land clearing or bulldozer blades should be deployed to the FSB site by heavy-lift into two sections. It requires two sorties by a CH-54 to accomplish the lift. Another tractor that can be helilifted into the base is the "mini-dozer" or 10,000-pound airmobile (MIL-T-52510/MD) tractor. It can be helilifted into the base in one piece using one sortie. The capabilities of these small tractors should not be overestimated, but they can speed up the construction of the FSB significantly. They can level bamboo, cut small trees, move large fallen timber, and dig emplacements as well as do rough grading and leveling of the FSB site. As can be seen in table 3-9, the production rate of this light tractor with a shearing blade decreases rapidly in vegetation above 12 inches in diameter, so explosives or chain saws should be used for the larger vegetation.

4-3. Base Camp Clearing

Normally, large base camps are developed along major lines of communication (LOC) and are cleared during the initial construction of the LOC or like area clearing as described in chapter 2. The major problems encountered at these fixed installations are the initial clearing and maintenance of fields of fire. Because long term clearing is required, the most complete job possible must be done initially, especially in the belts where barbed wire, mines, or trip flares are to be installed. Weeds and brush growing up through these obstacles are almost impossible to clear without completely removing and reinstalling the obstacles. If these areas are disked or thoroughly cleared with a rolling chopper prior to installing the obstacle the problem will be reduced. Herbicides can also be used to retard regrowth. When totally clearing or disking slopes greater than 10 percent, erosion control measures must be taken. Dust control and a reseeding program must be established in cleared areas near airfields and heliports. Complete clearing to bare soil should be avoided around these facilities. The maintenance of fields of fire is best accomplished with a mower once a good stand of grass has been established.

Section II. CONSTRUCTION CLEARING

4-4. Introduction

Land clearing as a construction operation consists of clearing a designated area of all trees, brush, other vegetation, and rubbish; removing surface boulders and other material embedded in the ground; and disposing of all the material cleared. Grubbing is the uprooting and removing of roots and stumps. Stripping is the removal of the organic topsoil and sod. Clearing operations to facilitate construction work normally include clearing and grubbing and

may include stripping, whereas tactical land clearing, described in chapter 2, usually only requires felling of the vegetation. Although the area cleared for construction is usually smaller than that required for tactical purposes, the specifications are much more stringent so the amount of effort expended per acre is considerably greater.

4-5. Requirements

The constructing agency or unit is responsible for determining the clearing requirements that are part of the construction mission. Often in tactical support construction missions, tactical clearing adjacent to the construction project will be accomplished in conjunction with the construct ion clearing. This is especially true for tactical road construction where a strip 200 to 500 meters wide is cleared to tactical clearing specifications while the center area where the road is to be built is cleared, grubbed, and stripped at the same time to facilitate construction.

4-6. Specifications

Because of the effort required and the erosion and duet control problems created by total clearing, only the minimum amount of clearing, consistent with the tactical and construction requirements, should be accomplished. Removal of the sod cover, especially around airfields, should be avoided whenever possible. Clearing, grubbing, and stripping are required in all cut or borrow pit areas, and in fill areas of less than 4 foot depth. In fill areas greater than 4 feet, normally just surface vegetation is cleared. If the specifications permit and deep fills are to be constructed, significant time and effort can be saved by shearing the vegetation in these fill areas at ground level and grubbing only in the cut and transition areas. Clear areas and approach zones adjacent to runways and heliports normally do not require that subsurface vegetation be removed (often even piling is unnecessary — see fig. 4-4). Rights-of-way for powerlines and pipelines also require only surface clearing.

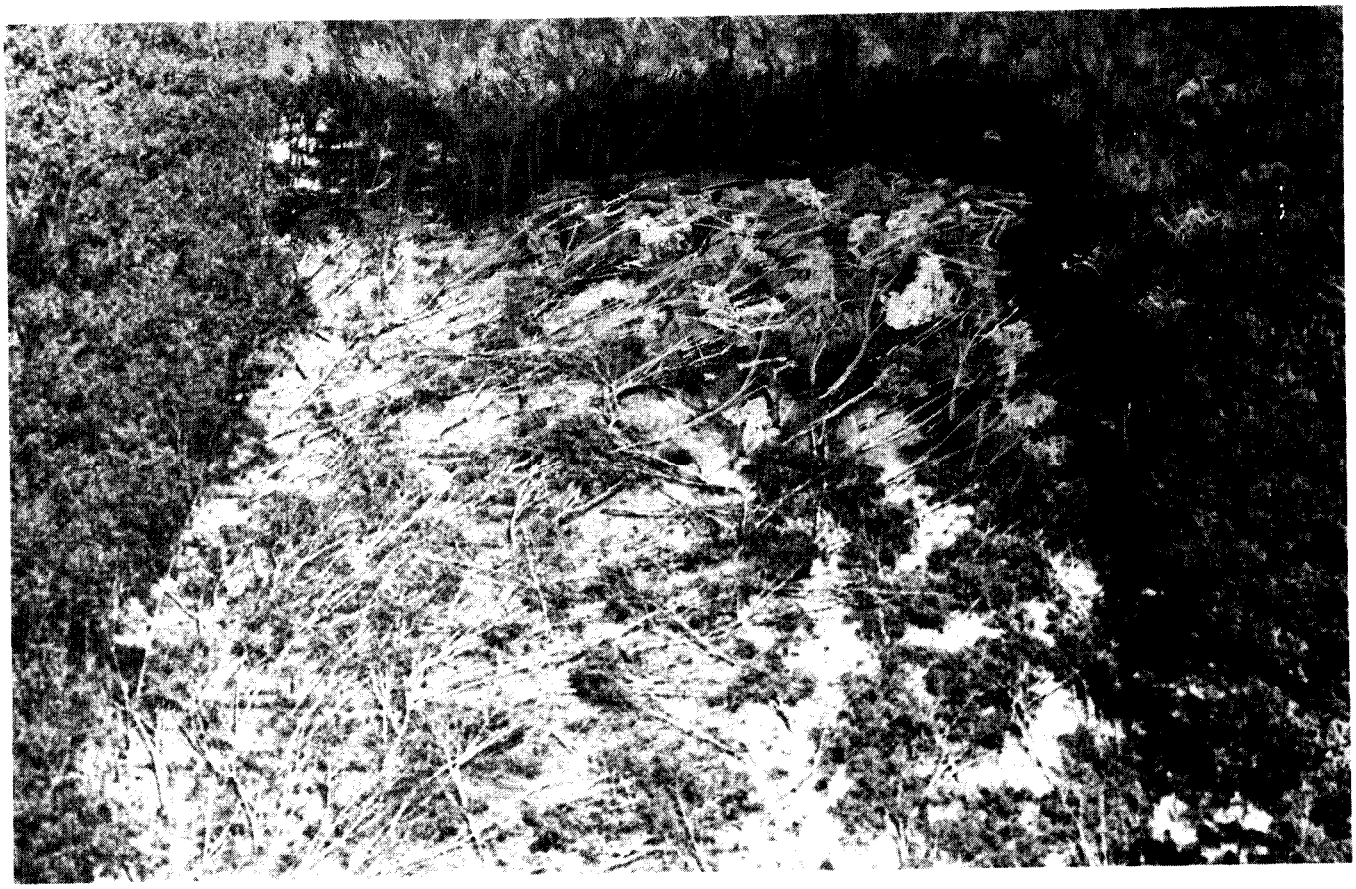

Figure 4-4. Trees felled at end of runway to provide better glide angle for incoming aircraft.

4-7. Techniques

The basic patterns of movement and organization of the clearing area used for construction clearing are the same as those described in chapter 2 for area or strip clearing. Because the areas are small compared to those in tactical clearing the bulldozer is often the most practical and available tool. It can be immediately used for earthwork without changing the blade. A motor grader or scraper can be used for clearing and stripping of light vegetation less than 2 inches thick. It may also be used for stripping turf for sodding bare areas. When the stumps are to be removed, the tree should be uprooted initially rather than cut so that the added leverage of the standing tree can assist in removing the roots. The bulldozer, spade plow, tilted Rome K/G blade, and knockdown beam are the attachments most frequently used in construction clearing and grubbing. When clearing in a rainy climate, all holes in the soil formed by uprooting the trees should be filled immediately after felling the tree to prevent saturation of the subgrade. Phased development of the drainage system in the early stages of clearing, grubbing, and stripping is essential to insure uninterrupted construction. For disposal of cleared materials, waste areas or burning methods are used, depending on the type of construction, location, and amount of time. Generally, the material is pushed and skidded off the construction site and into the surrounding timber to speed disposal and to keep the area cleared for equipment operation. In all cases, the disposal should be done as rapidly as possible by assigning specific units of equipment to accomplish this operation concurrently with the clearing and grubbing. The type of disposal method selected should be consistent with the methods of camouflage, salvage, and drainage used for the clearing operation. In forward combat areas where the saving of time is essential, the quickest and most convenient method of disposal of all materials is to pile or dump the materials adjacent to the work area. A study of the construction plans will show where the debris can be piled without interfering with drainage or possible work areas. In the construction of the main project, it may become necessary to clear a portion of adjacent land for use in disposing of the cleared material. This clearing for disposal of debris should be located as close to the main project as possible to shorten the hauling distance. Timber useful for logs, piles, and lumber is trimmed and stockpiled for future use in bridge, culvert, and other types of construction. This type of timber is pushed or skidded into a salvage area from which it can be later removed to a sawmill with little difficulty.