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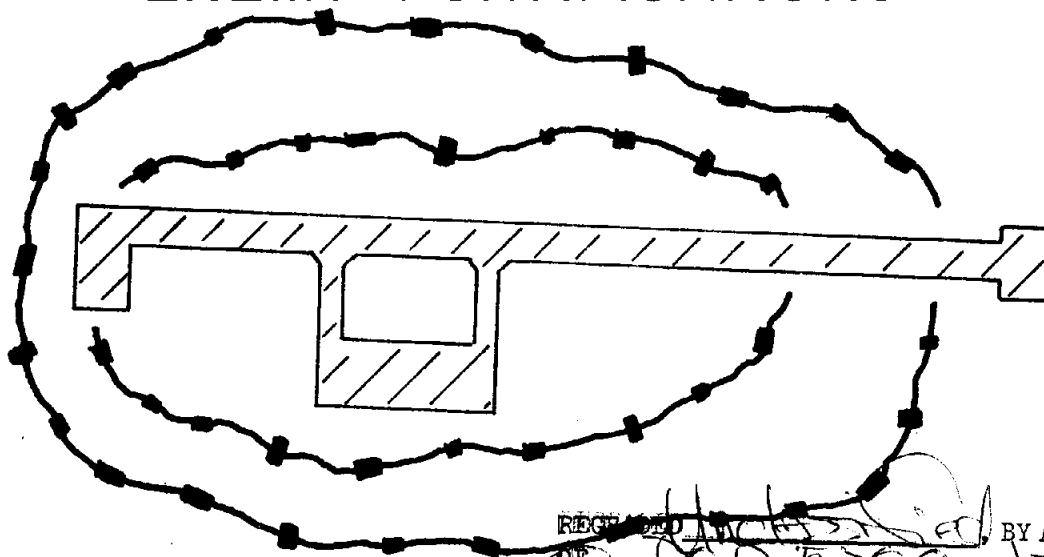
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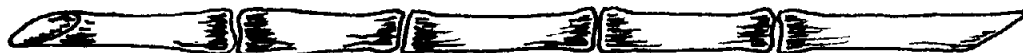
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ANALYSIS OF ENEMY POSITIONS AND EVALUATION OF THE EFFECTIVENESS OF WEAPONS SYSTEMS AGAINST ENEMY FORTIFICATIONS



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10 September 1968


SUBJECT: Vietnam Lessons Learned No. 69: Analysis of Enemy Positions
at Khe Sanh and Evaluation of the Effectiveness of Weapons
Systems Against Enemy Fortifications

SEE DISTRIBUTION

1. Attached for your information is a Lessons Learned from current combat operations in South Vietnam. This Lessons Learned is based on a very comprehensive and complete study made by the 3rd Marine Division under the cognizance of III Marine Amphibious Force.
2. The information contained in the Lessons Learned may be of value for direct application to training, or to reinforce existing doctrine, based on combat experience in South Vietnam.
3. Comments or questions concerning the document, or requests for changes or additions in the distribution of Lessons Learned, should be addressed to this headquarters, Attention: MACJ343. Lessons Learned published prior to 1968 may be obtained from the Defense Documentation Center.

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VIETNAM LESSONS LEARNED NO. 69

ANALYSIS OF ENEMY POSITIONS AT KHE SANH AND EVALUATION OF THE EFFECTIVENESS OF WEAPONS SYSTEMS AGAINST ENEMY FORTIFICATIONS.

(This Lessons Learned is based on a study made by the 3d Marine Division under the cognizance of III Marine Amphibious Force)

1. (U) INTRODUCTION:

a. The purpose of this lessons learned is to analyze the enemy positions at Khe Sanh and to evaluate the effectiveness of various weapons systems against enemy fortifications. The enemy's tactics at Khe Sanh were somewhat different from those previously encountered by US forces, but his defensive concepts relating to the use of trenches, tunnels, and fortifications were similar to ones used previously.

b. All of the position types were examined from an engineering aspect, then analyzed in relation to the supporting arms employed against them. Where possible, their tactical location and relationship to other nearby positions were studied to determine their purpose, interrelationship, and ability to withstand assault by fire. No attempt was made to determine or define the overall scheme of operations of the NVA forces at Khe Sanh. These positions represent a small fraction of the battlefield but should be considered as representative of NVA construction and placement.

c. The friendly weapons systems proved to be highly effective against the enemy fortifications. This was evidenced by the enemy abandoning the battlefield, leaving behind mounds of supplies and piles of unburied dead, a rare and, in Asian eyes, a particularly disgraceful act.

2. (CMHA) INDIVIDUAL FIGHTING/LIVING HOLES (SEE APPENDIX A):

a. Individual fighting holes were designed to afford both

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protection from fire and shelter from the elements for the occupants. The holes were dug first, then lined with locally procured materials. Cover was placed on the top and served as a means of protection and camouflage. The typical hole measured 3x6x4 feet (Fig. 1) and was carefully and deliberately camouflaged. Estimated occupancy was from one to three days. No supporting arms were employed against this type position.

b. The holes were located on the southeastern slope of Hill 678 (XD 851328) approximately 10 feet from a heavily used trail. Foliage consisted of dense bamboo thickets, banana trees and miscellaneous broad leaf trees which formed a canopy between 15 and 40 feet above the ground.

c. The positions served as a temporary resting place for small groups of people moving long distances, or were used by the point or advance guard of a large unit. The absence of spoil, waste and other human evidence suggested the former, although a large complex was found several hundred meters away.

3. (CMHA) UNIT BIVOUAC SITES AND HASTY POSITIONS (SEE APPENDIX B):

a. Hasty positions were constructed for rapid protection and short occupation. They varied in size from single individual sleeping holes to company and battalion sized complexes consisting of multiple fighting holes and storage areas. The absence of trenches indicated that the area was not exploited for prolonged defense. No individual camouflage precautions were present. The spoil was piled on the edges of the holes to form a protective berm. Holes were scooped out and lined with leaves and matting. No supporting arms were employed against this position.

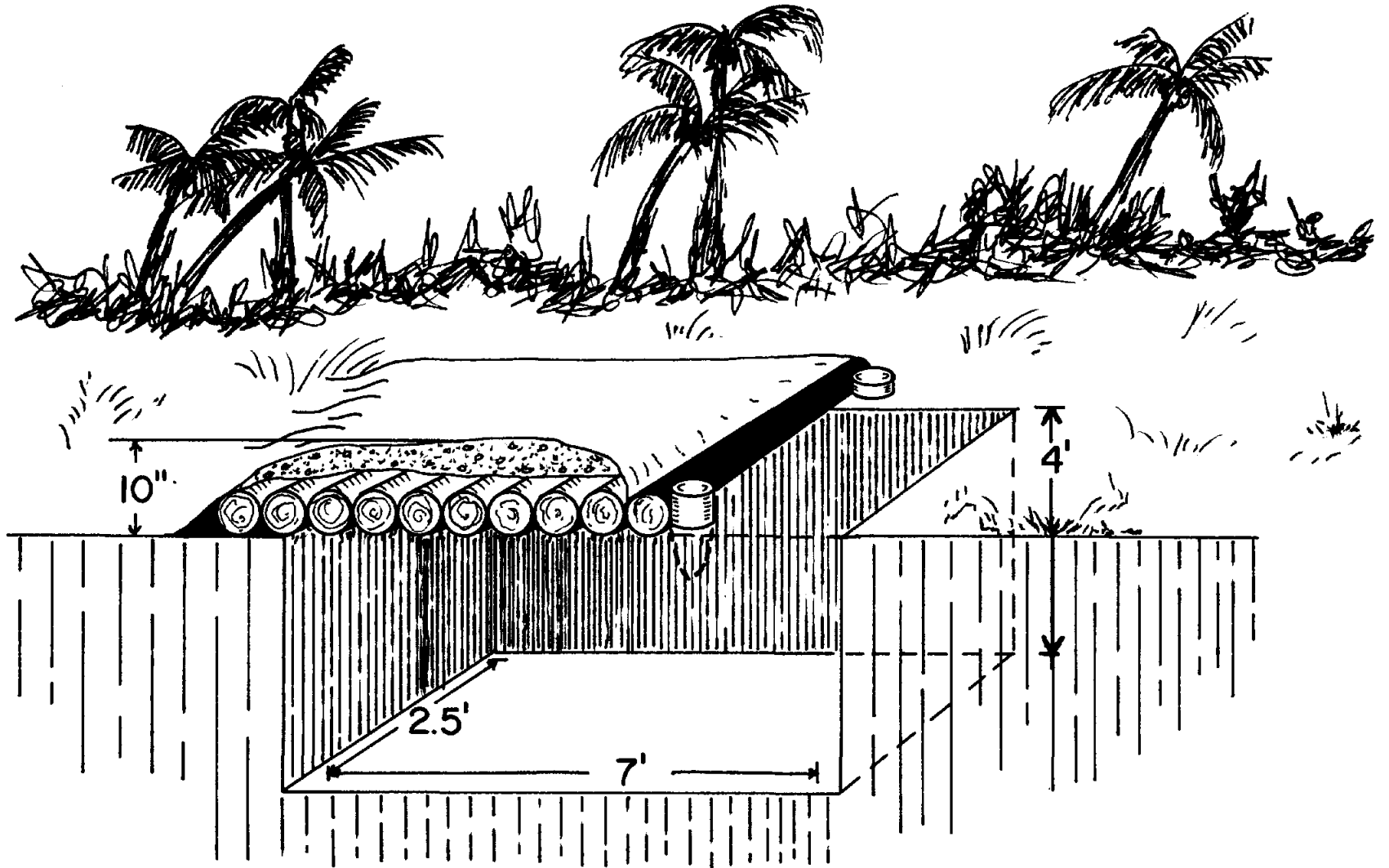
b. Figure 2 shows the general design and layout of a large bivouac site located under a solid tree canopy at XD 855322. The hill mass ran in a north-south direction at an altitude of 500 meters. The complex was located on the east side of the hill, 200 meters above the Khe Cham River. The area followed closely the pattern of most living areas, i.e., on reverse slopes between the topographic crest and the nearest water source. Where heavy canopy exists no concealment measures were taken, however, heavy security was placed on the perimeter of the area. Subsequent observation flights could not locate the position under the canopy.

c. All indications pointed to this area as a stopover point for a company sized unit. There were over 100 various-sized sleeping and fighting holes in the area, each group of sleeping holes protected by an outer perimeter of fighting holes. Within the inner perimeter, sleeping holes were scattered in a random fashion, generally along either side of the trail.

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FIG.1 INDIVIDUAL FIGHTING/LIVING HOLE

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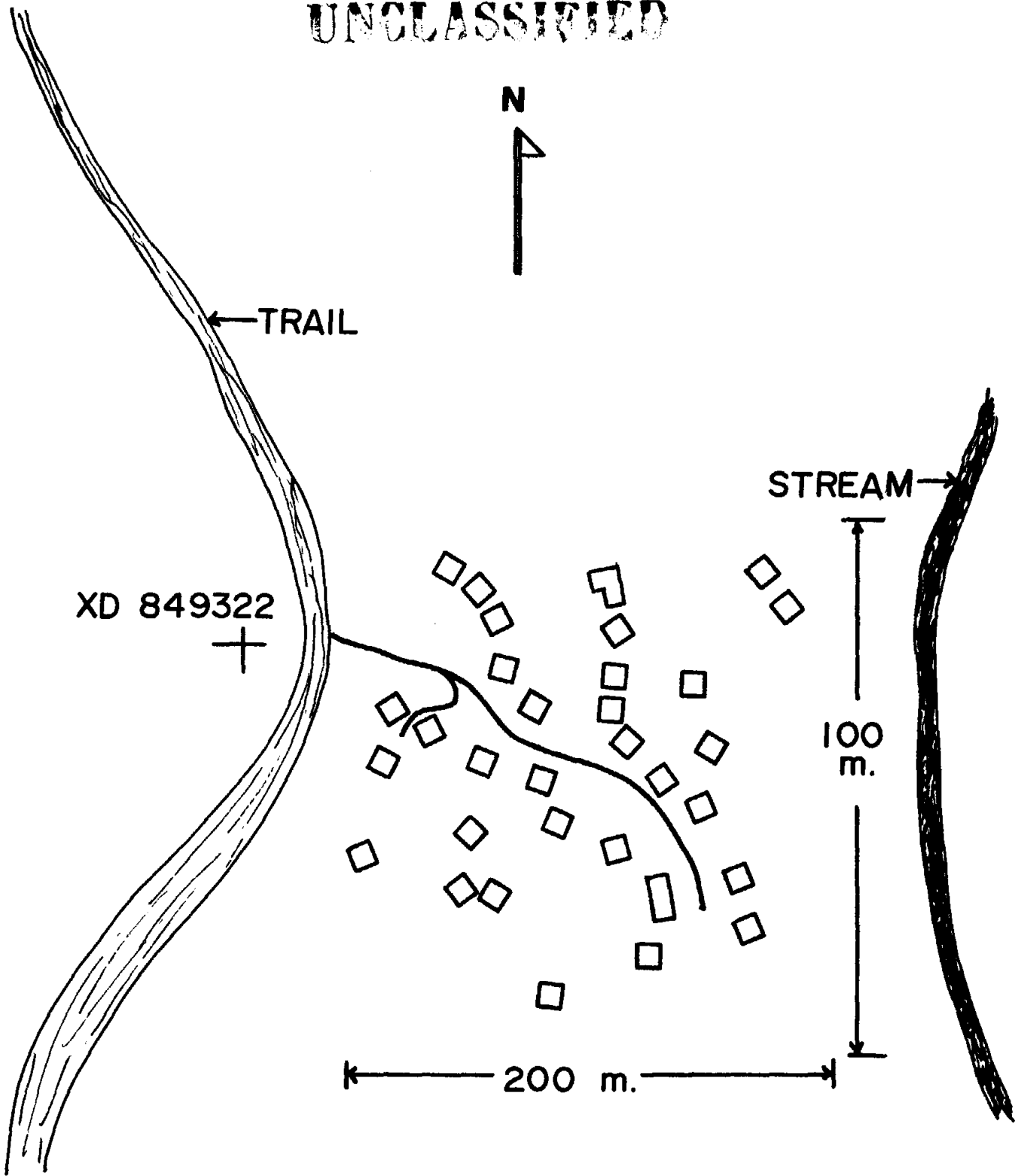


FIG. 2 COMPANY POSITION

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4. (OMHA) ANTI-AIRCRAFT POSITIONS (SEE APPENDIX C):

a. One of the most readily identifiable NVA fortifications was the single or multiple anti-aircraft site. Single positions were used in conjunction with living areas, trench complexes, supply routes, and are located within each complex, or directly adjacent to it. Multiple positions in either a triangular or linear formation were employed on hilltops and high terrain to provide security to base areas, storage and logistic points. These positions were in single groups or mutually supporting complexes. Each position was capable of independent action. Figures 3 through 5 illustrate the positions located at XD 847317 and XD 853309. Figure 6 describes the single 57mm position at XD 833378.

b. The positions were located on a ridge line which extended from XD 844316 to XD 850305 in a southerly direction. Each position afforded an excellent view of the surrounding terrain. No attempts were made to camouflage either position, although the command and control bunker in figure 5 had been camouflaged prior to a fire which had burned across the position. Trenches connected each gun position within the complex but the two main positions were connected only by a trail and communications wire. Both positions had short escape trenches leading to a concealed area 60 feet away. No evidence of a living or storage area was seen from either ridge. However, subsequent photography revealed two large bunker complexes at XD 844315 and XD 854312. 12.7mm brass was recovered from both these locations.

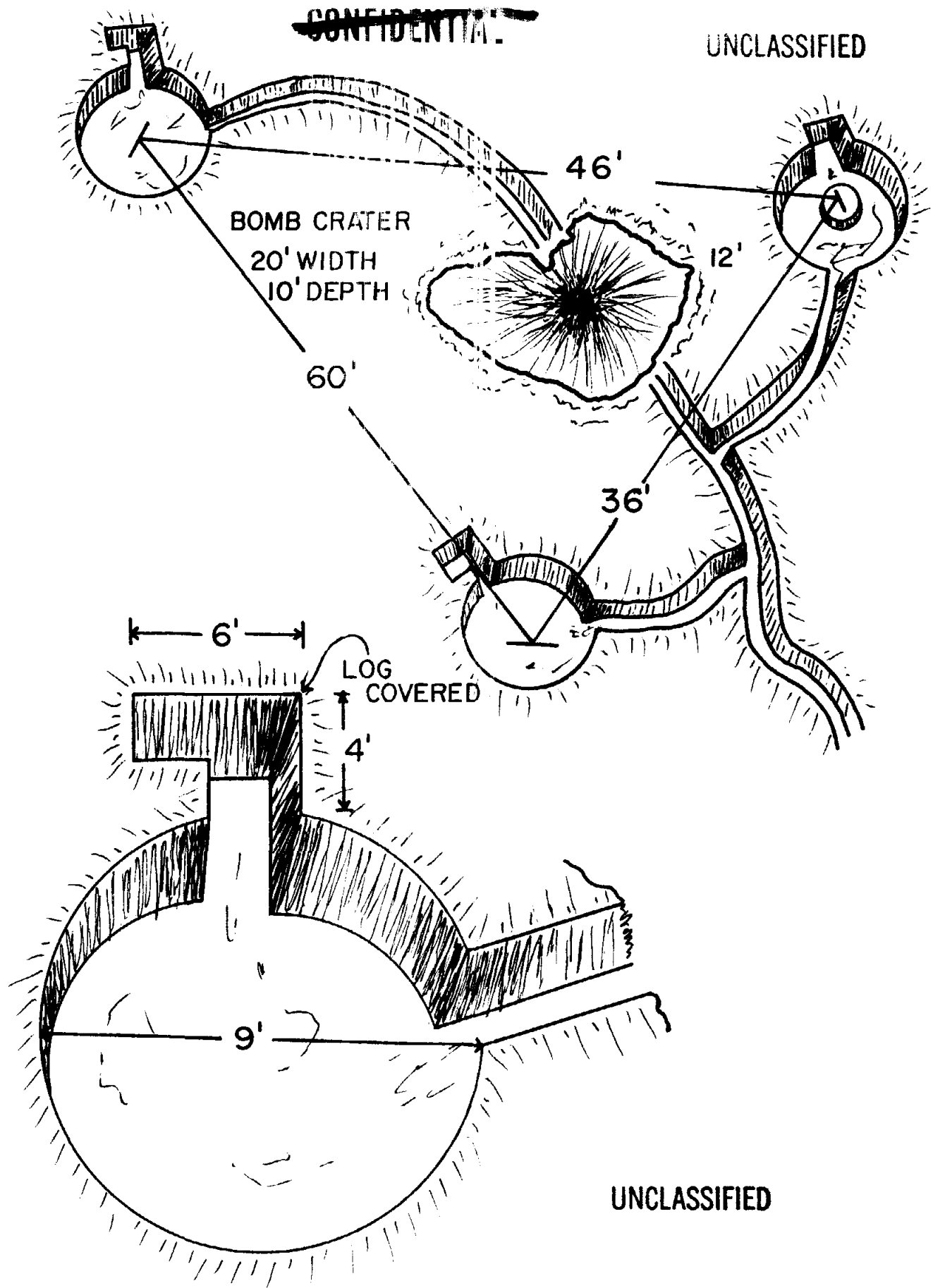
c. The holes were well constructed, especially the ammunition storage and protective bunkers associated with each position. These bunkers (Fig. 4) gave adequate protection from anything but a direct hit. The bunkers had 3 feet of mounded overhead cover consisting of 3 inch logs, rock, and earth fill. One or two holes in each complex contained center pedestals 8 inches high and 2 feet in diameter. The linear position measured 100 feet long. A 4x6x4 foot command/control bunker was located 20 feet to the rear. Connecting trenches had one 3x6x3 foot protective bunker cut into the side. Communications wire was scattered throughout the area.

d. During Operation Pegasus, elements of B/2/5 Cavalry, 1st Air Cavalry Division discovered an S-60, 57mm AA gun site at XD 833378 (Fig. 6). The terrain in the area was flat and consisted of knee-high grass and scrub growth. A well used trail leading from Route 9 indicated that the gun was towed into position by a tracked vehicle or truck. Few fortifications were found in the area. The circular gun pit was 30 feet in diameter, 6 feet deep, and the spoil had been flattened out around the position. The gun itself had been damaged from a near miss. Numerous other bomb craters were located within 30 feet of the pit. The carriage was broken in two places, two wheels were broken off, and the sights, range finder, and miscellaneous on-carriage equipment had suffered heavy damage. There was

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FIG.3 TRIANGULAR 12.7mm AA POSITION

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3' OVERHEAD

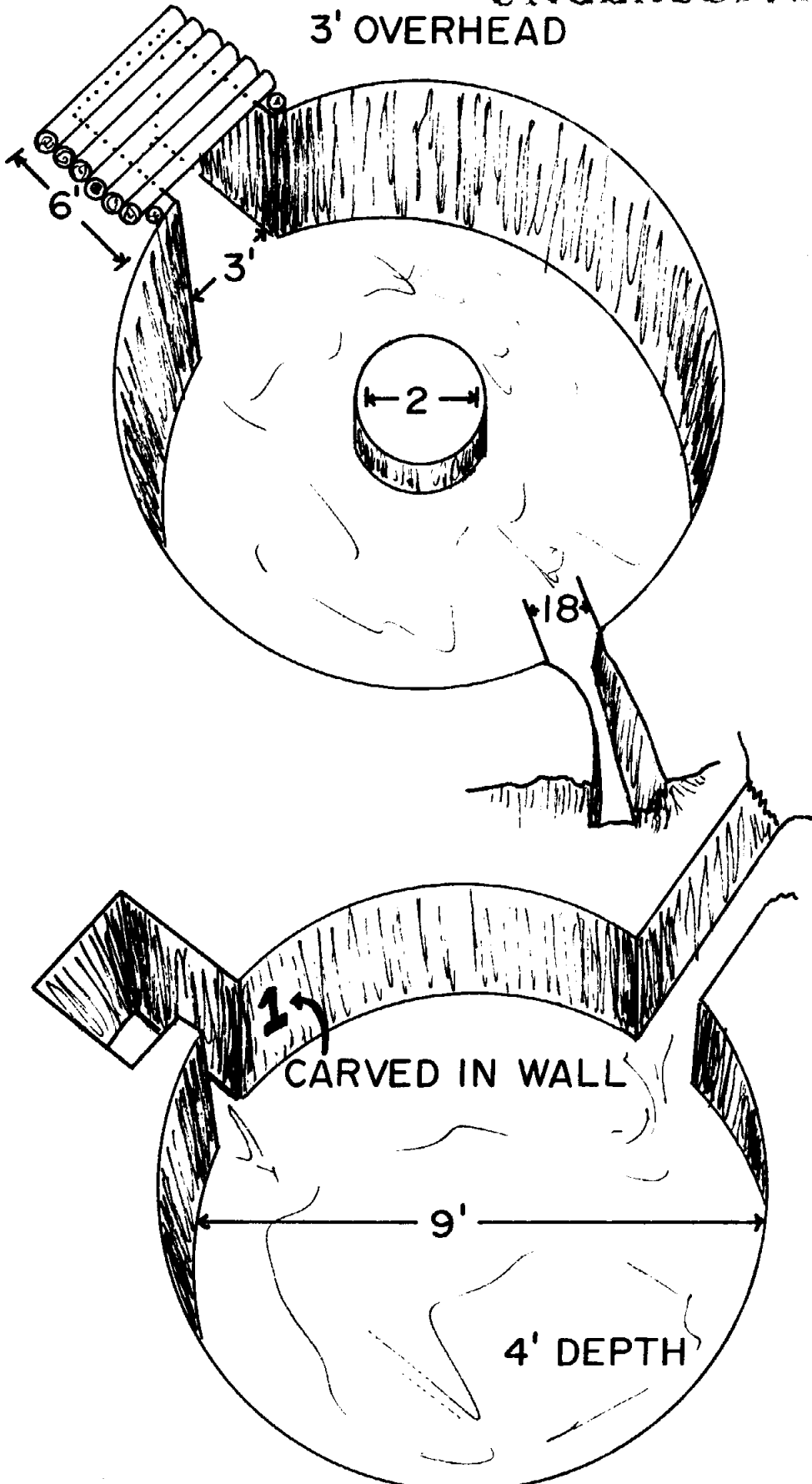
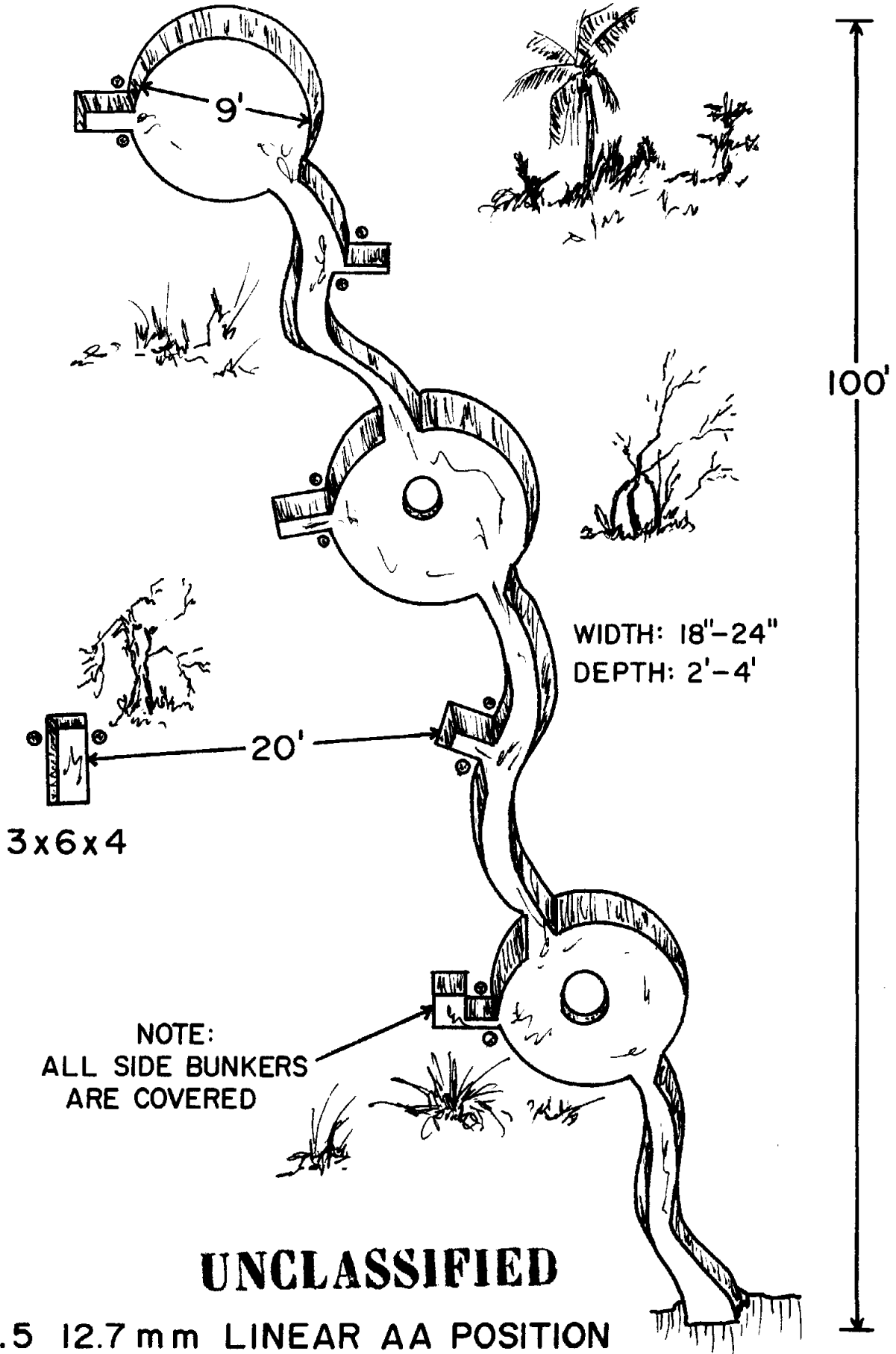


FIG. 4 12.7 mm AA PITS

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FIG.5 12.7 mm LINEAR AA POSITION

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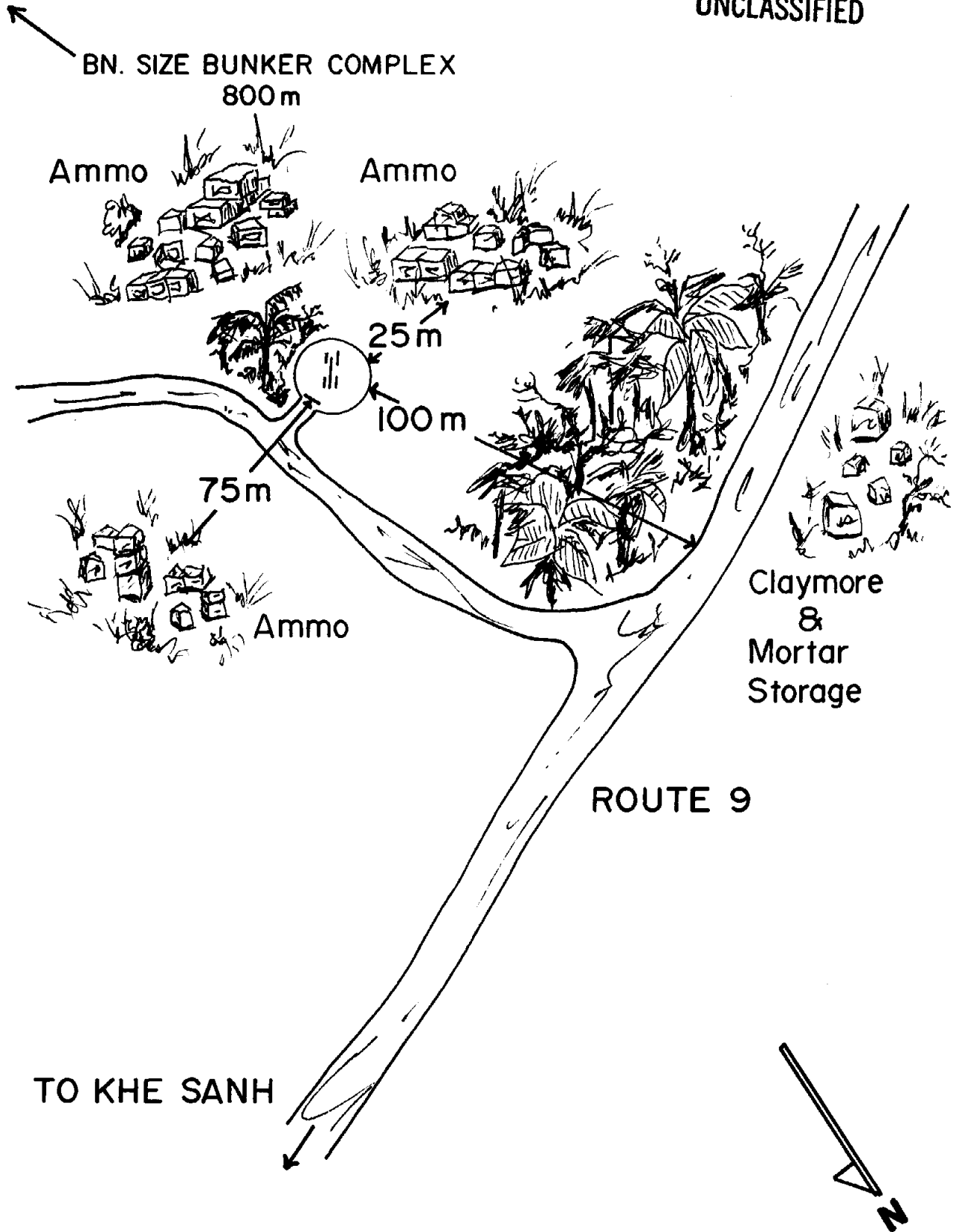


FIG. 6 57mm AA SITE

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no apparent damage to the tube. A large battalion sized bunker complex was located within 800 meters of the site. CHICOM claymore mines and mortar rounds were found within 150 meters of the gun. Again, the pattern of protection for the ammunition storage and living areas was followed.

e. Of the sites inspected and photographed, the triangular position at XD 847317 had been attacked with the greatest accuracy. Figure 3 and the photos in Appendix C show the single 500/750 lb. bomb crater placed directly in the center of the three positions. There was no visible damage to any of the positions, or to the living/storage bunkers cut into the side of the gun pit. The accuracy of the bomb placement and comparison of the crater to others within 100 meters of the position indicated the position was visually acquired and attacked.

5. (CMHA) NVA HILLTOP DEFENSIVE POSITIONS (SEE APPENDIX D):

a. The defensive positions encountered on Hill 663 (XD 828321) consisted of forty to fifty "tepee" style living and fighting bunkers arranged in mutually supporting concentric circles just below the topographic crest of the hill.

b. The hill was partially wooded with large patches of elephant grass and low shrubs. The gradient on the western slope averaged 45 degrees. The hill sloped to a small plateau located 150 meters to the east on a small finger. The soil was of laterite composition with no rock present. Excellent observation and fields of fire were available in all directions. The NVA had used the hill as a defended observation post and strong point protecting the southern approach to Khe Sanh. The position presented a defense in depth from any approach. No booby trap devices were encountered by the troops occupying the hill.

c. The "tepee" style bunker consisted of an A-Frame overhead cover arrangement and was unique among the various bunkers seen on the battlefield. There were numerous reports confirming its widespread use throughout the Khe Sanh area. The bunker was constructed in the standard 4x6x4 foot fighting hole, giving it an underground "pup tent" appearance (Fig. 7). This type construction offered the best protection, exposed very little to the observer, and was one of the strongest construction styles devised. The 4x6x4 foot trench provided the basis for the bunker with each side entrance faced at right angles to the direction in which the bunker was oriented (Fig. 8).

d. Overhead cover for these bunkers consisted of locally procured materials and maximum use was made of cover and concealment. The

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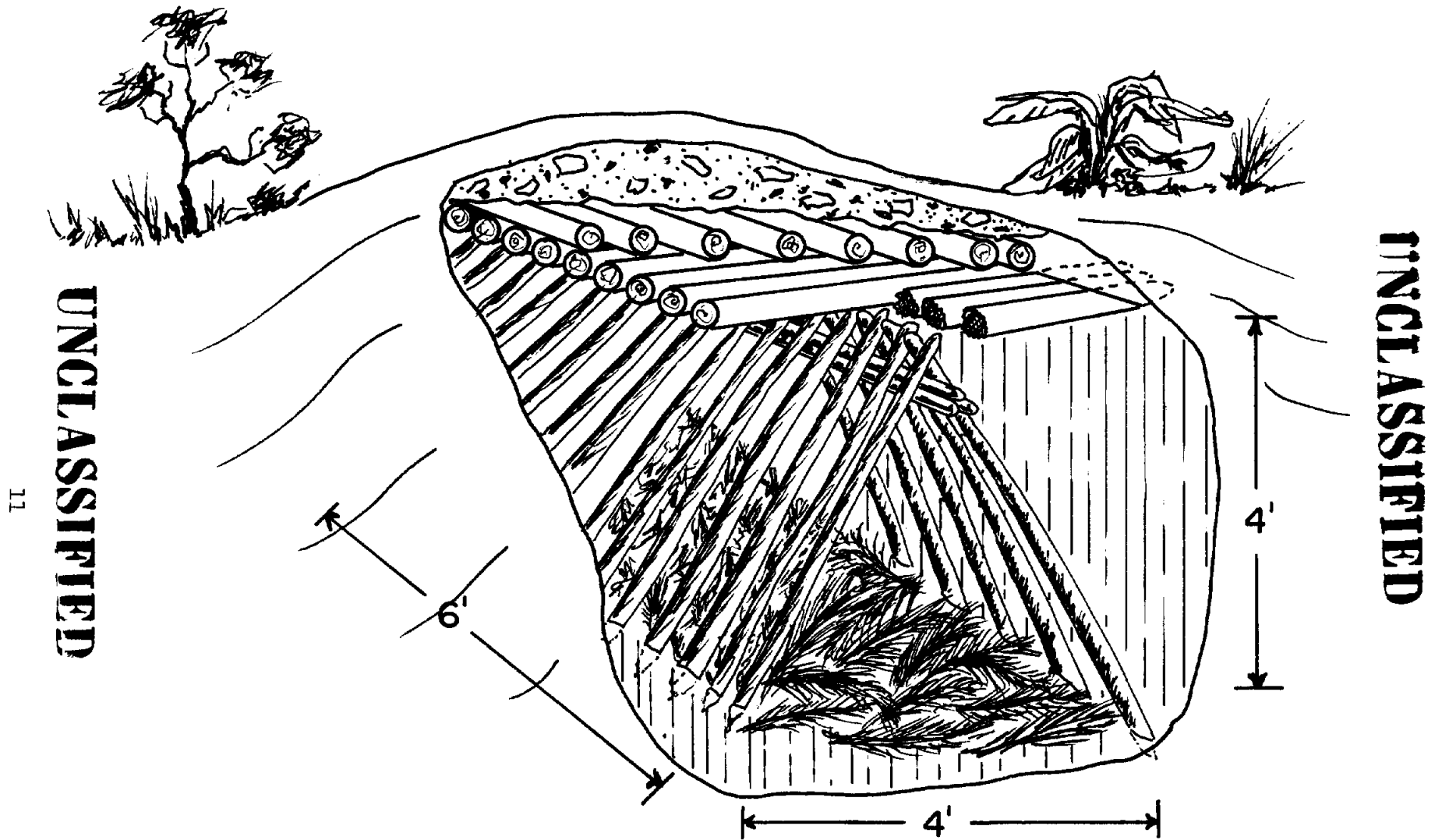
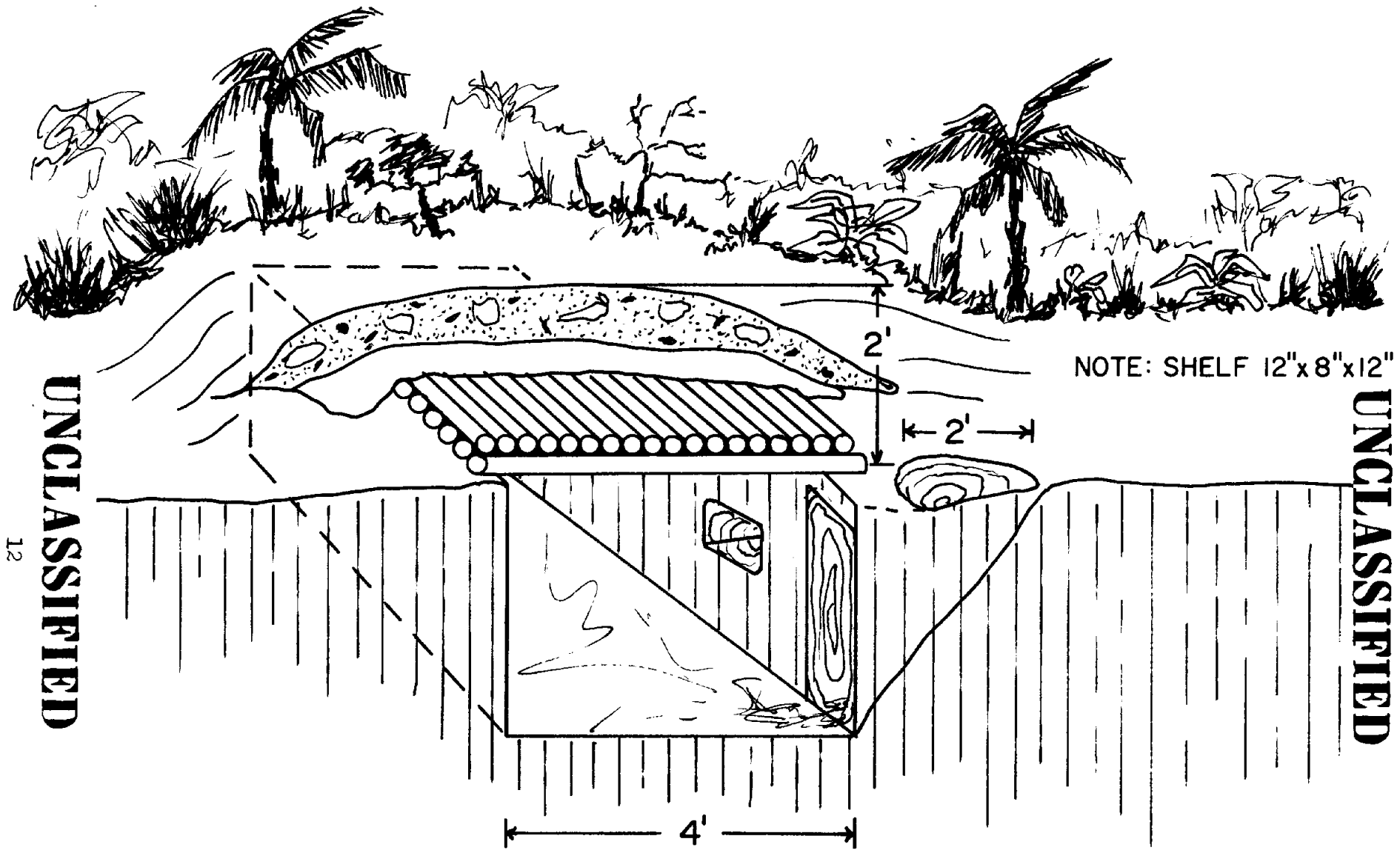


FIG. 7 A-FRAME BUNKER
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FIG. 8 STANDARD 4x6x4 BUNKER

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bunkers presented a low silhouette and blended with the terrain. Most of the bunkers were not seen from the ground beyond a distance of 10-20 feet. There were several standard characteristics noted for this style bunker, i.e.:

(1) Use of hardwood logs 3-10 inches in diameter arranged across a 4x6x4 foot trench.

(2) Woven elephant grass and bamboo leaf matting used as floor covering and to prevent the overhead fill from filtering into the bunker.

(3) Logs and miscellaneous debris combined with the laterite to form a light blast layer overhead.

e. The "tepee" bunker and its unique overhead demonstrated a basic engineering knowledge by the NVA soldier. The overhead logs measured 5-6 feet long and were embedded six to ten inches in the floor of the bunker at a 45 degree angle, forming an equilateral triangle. At the apex, the logs were lashed to a 12 inch center support beam. Where the 12 inch logs were not available, several smaller logs had been laced together. Entrances sloped from ground level to the bunker floor at a 45 degree angle, leaving a small hole that could be seen only from overhead. Each bunker contained a 6 inch air vent in the wall furthest from the entrance. There were no apertures found in these bunkers. Many of the bunkers were blown by the US forces with internally placed charges. This method destroyed the overhead protection but did not break the timbers or logs. In a few hours the bunker could be reconstructed. Figure 9 shows the NVA long handled shovel recovered at the site.

f. The hill was attacked with general purpose (GP) bombs, rockets, napalm and artillery. The napalm had burned away much of the underbrush on the eastern slope exposing several bunkers. Of those exposed, all were charred on the inside, but only the grass matting had burned and the structure had not been weakened. Numerous 250 and 500 lb. bomb craters were in close proximity to the positions, but no bunkers were found that had received a direct hit. Soil and bunker composition required attack utilizing delay fuzing; however, the artillery delay penetrated the soil six to eight feet before detonating and was of limited use against the bunkers. Surprisingly, the employment of quick fuzed artillery would have been more effective in lieu of a shorter delay mechanism. Eleven bodies were found in the complex above ground. Most were uncovered in their bunkers as the US troops dug in for the evening. The fact that they stayed on the hill in the face of heavy aerial and artillery

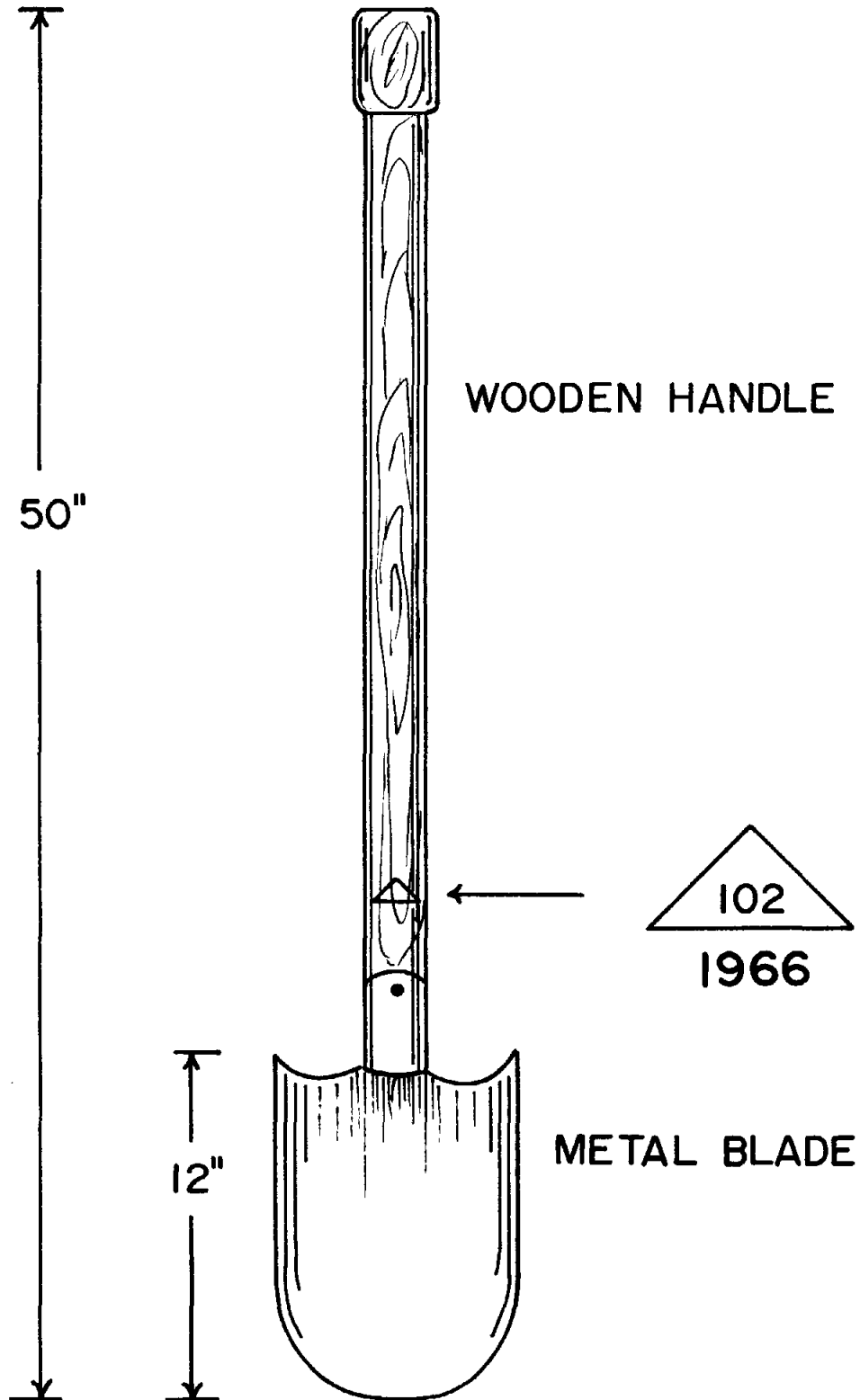


FIG. 9 NVA LONG HANDLED SHOVEL

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bombardment attested to the hill's significance. Although the bodies had been on the hill from 10-15 days, many were observed to have large fragment holes and similar disfigurements. One skull had a 2x5 inch hole, and several helmets with fragment holes were lying about the hill. The dead appeared to have been caught above ground by the bombs and artillery. The question facing the supporting arms planner in attacking a complex of unknown size and composition will normally involve fuzing requirements. Although the tendency to employ delay is strong, the planner must consider that soil composition may render the delay fuze useless. The probability of a direct hit is small, and the delay may penetrate through the bunker, exploding underground. In some cases, high angle surprise fire employing VT and quick fuzing may have more effect than a reliance on delay fuzing.

6. (CMHA) NVA FORTIFIED LIVING AREAS (SEE APPENDIX E):

a. The major trench system used to mask the approach to Khe Sanh paralleled the existing road network between the base and the village. The terrain throughout this area is gently rolling and forms a plateau which extends from the main access road east to the Riviere de Rao Quan. The overhead cover offered by the woods and heavy brush along the plantation roads provided excellent camouflage for the trench system. (See Appendix J for a diagram of the main trench system, living areas and access trenches.)

b. The approach trench system was well camouflaged and followed the natural terrain features whenever possible. The trenches changed direction every 10 to 20 feet and were serpentine-style. Large roots which could not be circumnavigated were left undisturbed. The depth of the trench was increased for added protection in open areas. Cooking utensils were scattered throughout the complex. Many of the vents and smoke holes had large boards placed over them at a 45 degree angle to deflect smoke and shield the hole from observation (Fig. 8). This was the only area where posts and braces were encountered in bunker construction. It gave the bunkers a much stronger overhead cover, and maximum protection to the occupants. It allowed the weight to be evenly distributed and provided for somewhat larger construction.

c. The staging and living areas branched from the system at periodic intervals and were well camouflaged with grass and shrubs. The area along the plantation road from XD 864400 to the base at XD 850415 was extensively trenched, one branch running east of the access road toward the eastern end of the runway and the other running west of the road toward the Khe Sanh Combat Base. The NVA had used the French plantation extensively for staging and living bunkers. Communications wire was noted throughout the area. Antiaircraft and mortar positions were strategically placed within the bunker system and were

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well camouflaged. A large bunker complex measuring 200x400 meters and containing 73 living bunkers was constructed at XD 858409 (Fig. 10). The area was open to observation but had been skillfully and carefully camouflaged in the elephant grass and scrub growth. There was little evidence of the spoil normally seen beside the trenches, and each bunker had overhead cover in which grass and bushes were planted. Antiaircraft positions had been placed on the outer perimeter of the complex and could bring fire to bear on the eastern approach to the airstrip (Fig. 11). Other complexes were reported at XD 879389, XD 878398 and XD 849389 (Fig. 12). All were interconnected to the main trench system. See Appendix I for similar positions.

d. The bunker complexes in the plantation area were constructed with material procured from the village and abandoned US and ARVN positions outside the base. Engineer stakes, sandbags, 4x4x7 feet standard cut timber, tin sheeting, and clear and green plastic waterproofing were all used throughout the complex. The bunkers closest to the base were the best constructed, having more than 3 feet of earth cover. Figure 13 shows a typical bunker of this type. A ceiling of solid engineer stakes followed by a layer of waterproofing or tin material, three feet of earth, logs and sandbags was not uncommon. Partially covered L-shaped fighting holes were also located in the area. The simplicity of the system and the ease with which the main trench system could be reinforced along covered routes was remarkable.

e. The entire plantation area had been extensively bombed and shelled from Khe Sanh and the 175mm artillery positions at Camp Carroll and Thon Son Lam. One B-52 strike was observed on the southwest portion of the plantation road. Crater analysis was easily performed in the soft laterite soil. Distinguishing between the various sized bombs was difficult, however, three types of craters were evident throughout the area, from which the following assumptions were made:

<u>Crater Size</u>	<u>Ordnance</u>
10' dia x 5' deep	250 lb. GP
15' dia x 8' deep	500/750 lb. GP
38' dia x 20' deep	1000/2000 lb. GP

The bombs which made the largest craters destroyed any evidence of bunkers or other positions that may have been there. Within the positions, only superficial damage was observed. Numerous craters were found within 10-15 feet of the access trenches. The adjoining bunkers (Fig. 14) were not damaged by bomb fragmentation. Concussion effects were speculative. In areas where the craters intersected the trenches and bunkers, extensive damage to both resulted. This was especially noticeable on the west side

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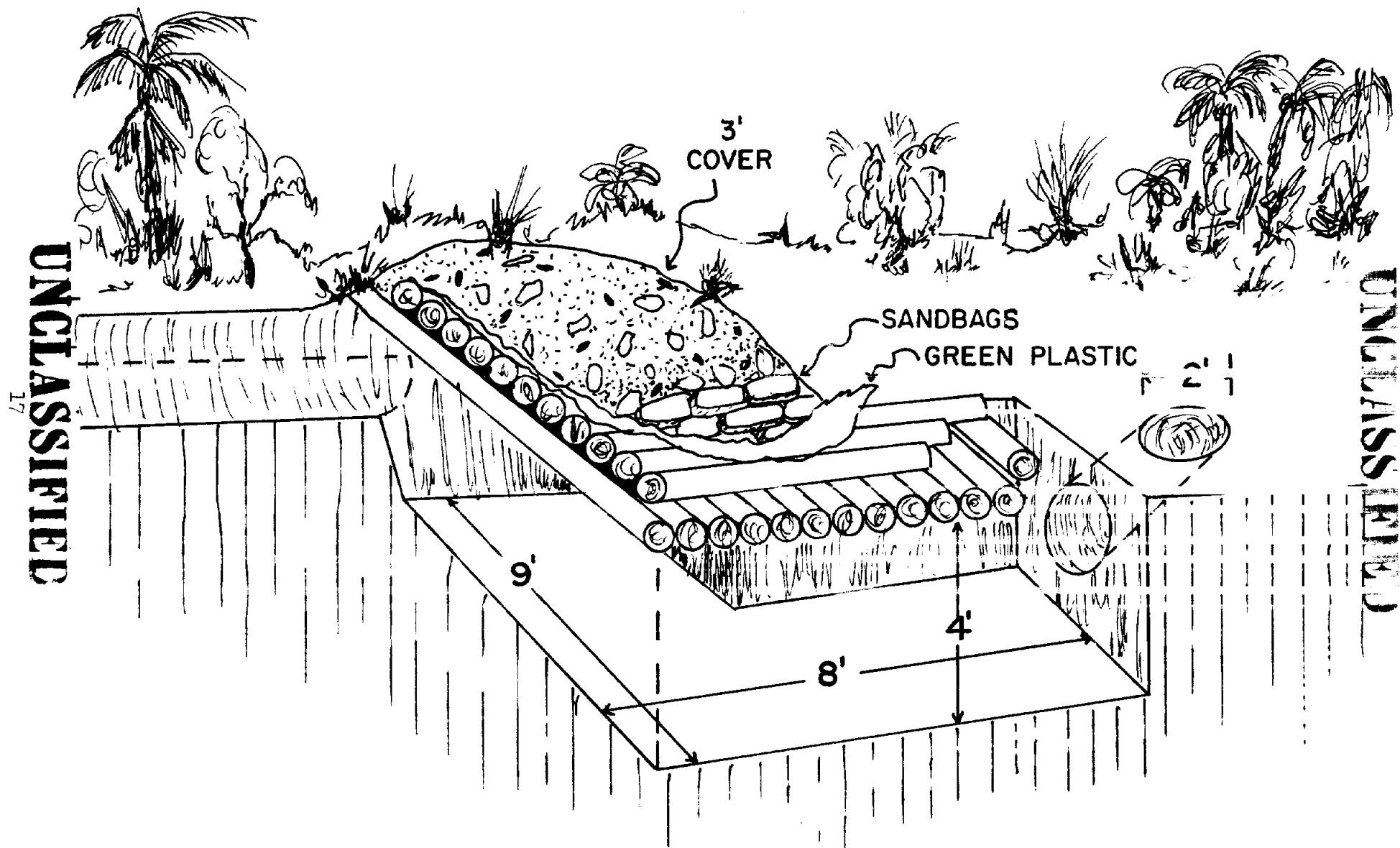


FIG.10 L-SHAPED LIVING BUNKER
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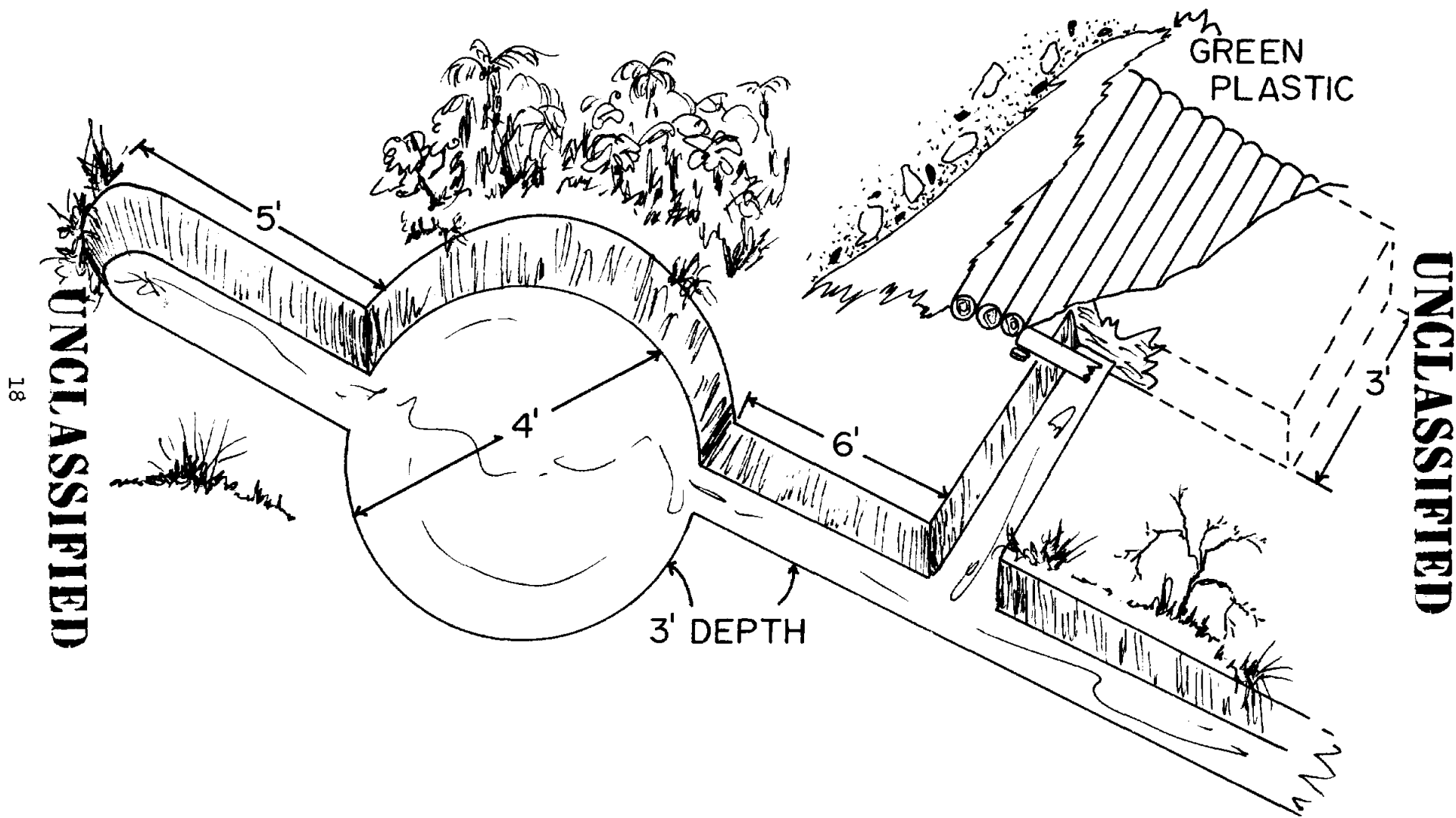
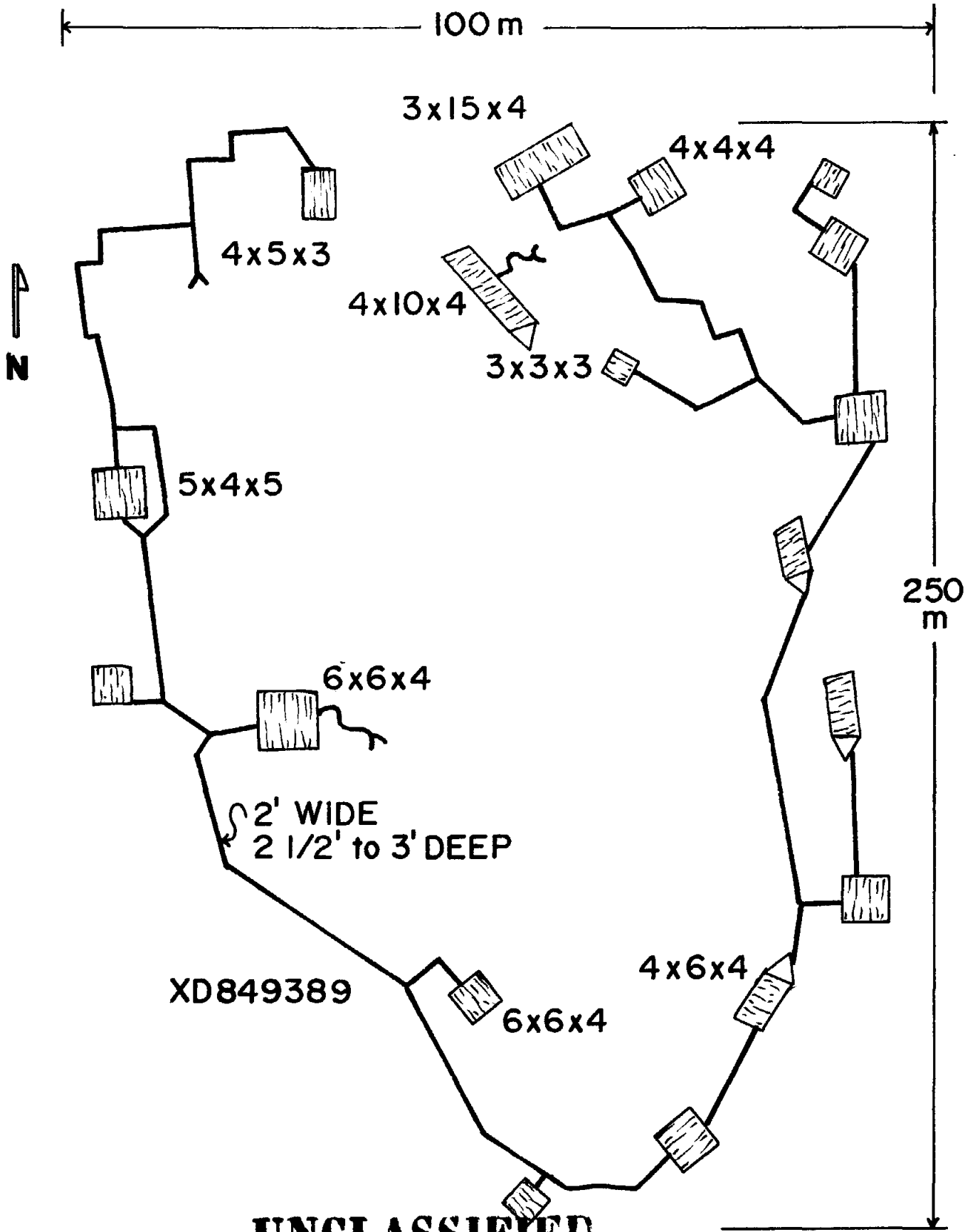


FIG. II AA/MORTAR POSITION

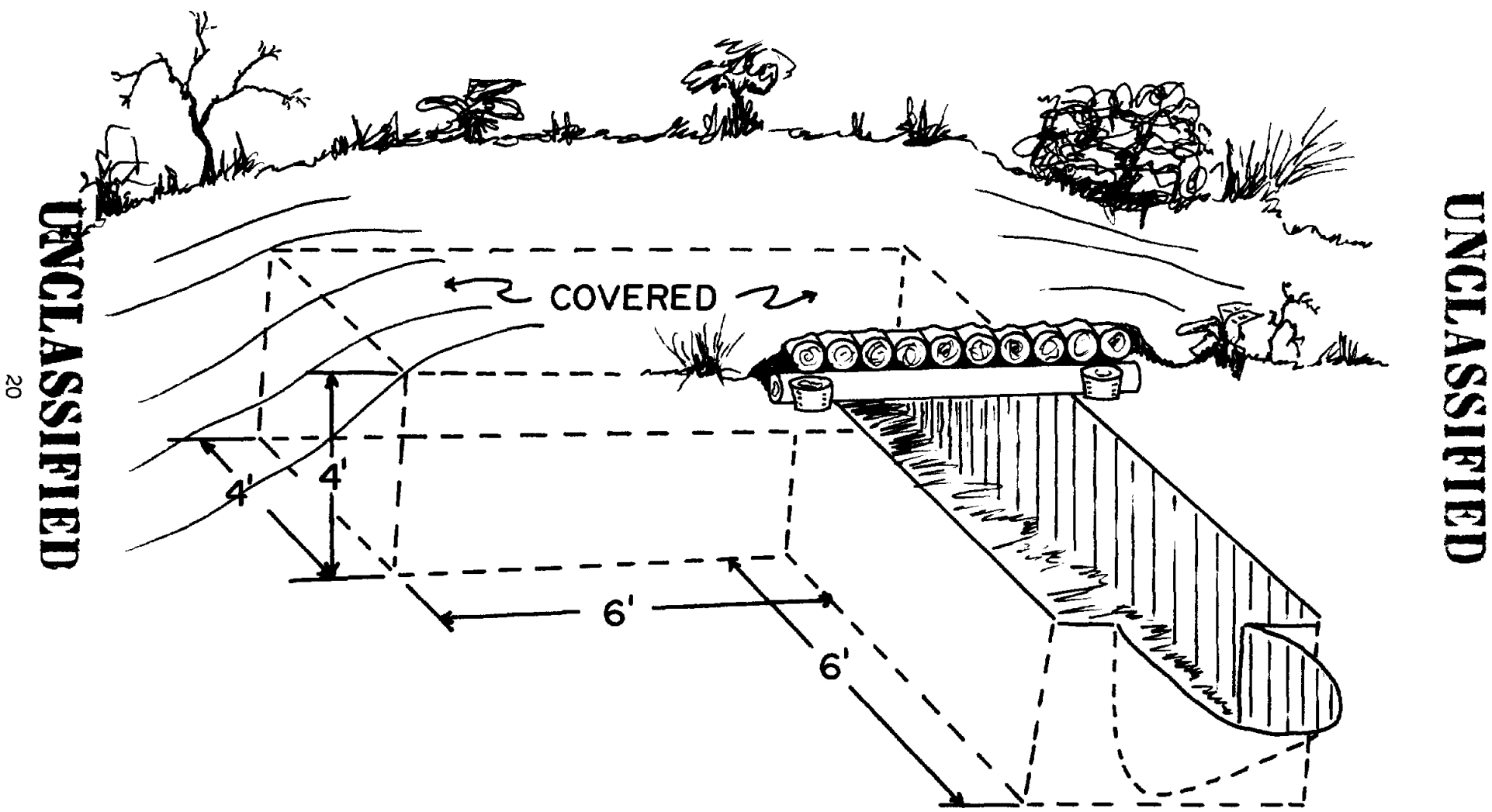
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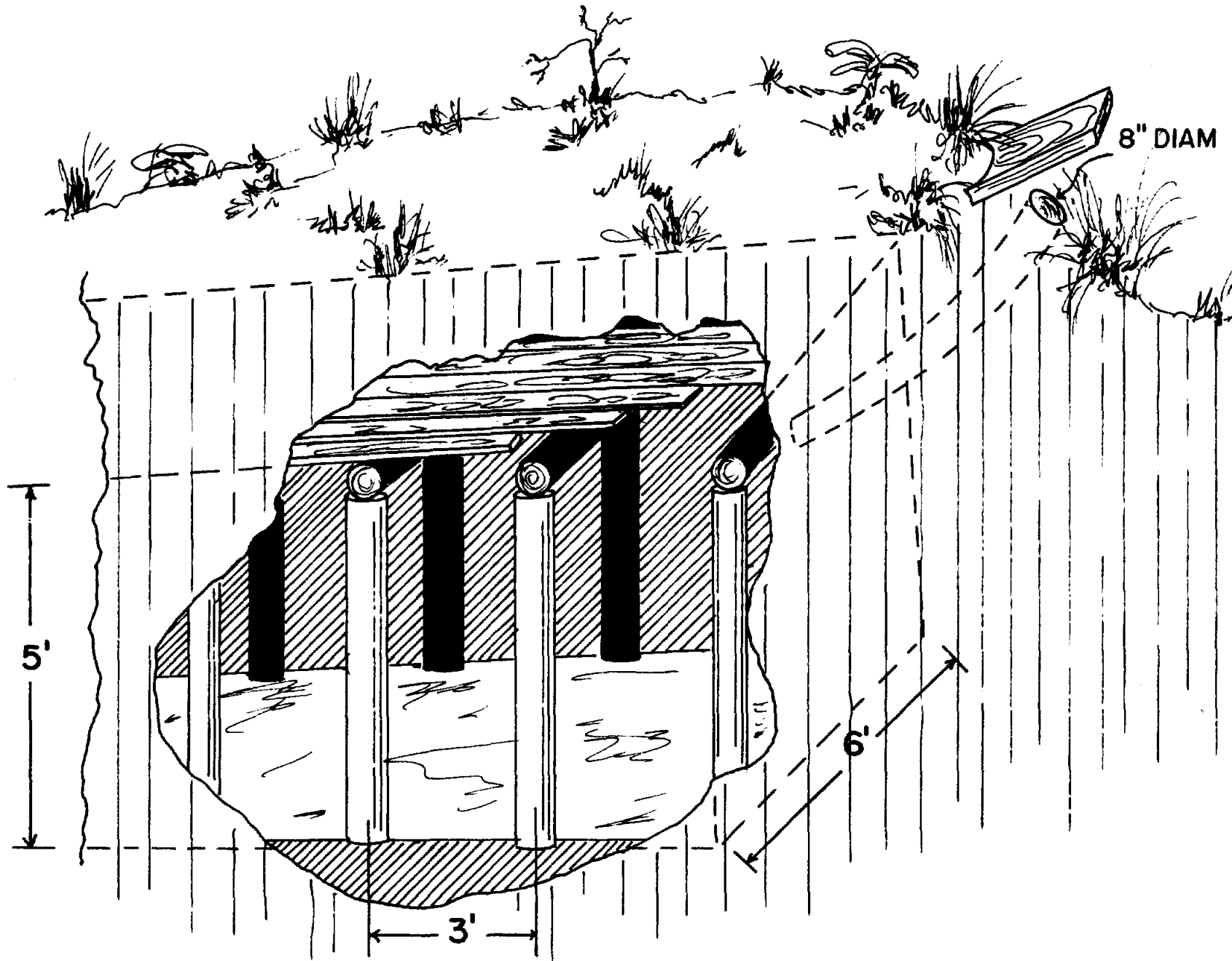
FIG. 12 LIVING BUNKER COMPLEX



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FIG. 13 L-SHAPED FIGHTING BUNKER

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FIG. 14 UNDERGROUND BUNKER

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of the plantation road in the vicinity of XD 856405. The use of napalm against the trenches was of no value unless the trench supporting the living bunkers was connected for such use. Likewise, elephant grass burned only at the roots leaving the tops green. The amount of ammunition needed to neutralize a bunker complex of this size was determined by the degree of observation and skill in employment. In many cases the close air support and radar bombing missions were made parallel to friendly lines to insure safety whereas the trenchlines extended toward the base in a "spider-web" design. Attacks made perpendicular of these targets considerably reduced the probability of damage.

7. (CMHA) ASSAULT TRENCH COMPLEXES (SEE APPENDIX F):

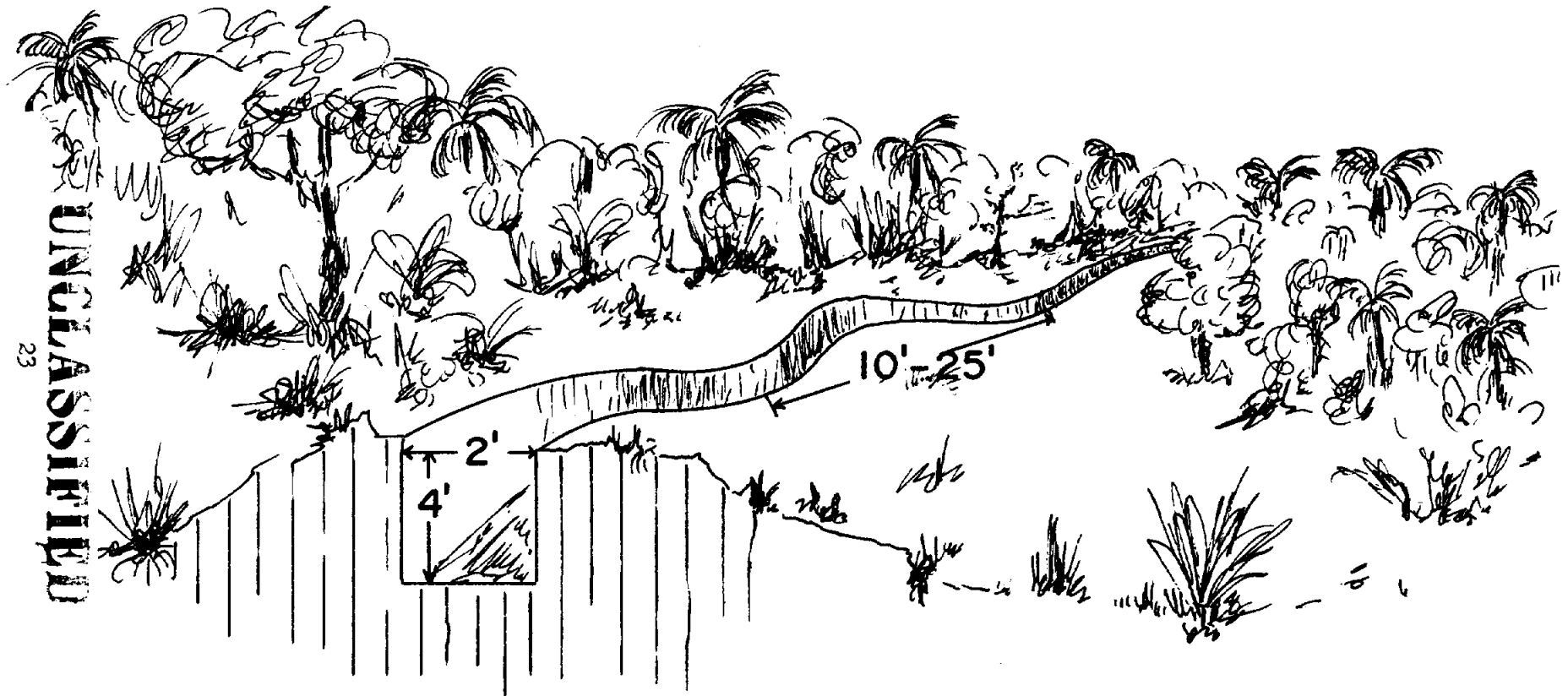
a. A major portion of the trenchlines on the perimeter of the base was explored in an attempt to determine their extent and tactical significance.

b. The assault trenches extended from the living areas discussed above, north to the base perimeter XD 853417. The serpentine system followed the existing road and trail network throughout the XD 8441, 8440, 8540, and 8541 grids. The area was generally flat with gently rolling hills. There was no elephant grass immediately outside the base perimeter, thus permitting excellent observation into the trench system from the air. No attempt was made to camouflage the trenches, and the soil was piled on either side forming a 18-24 inch berm.

c. A casual serpentine pattern was followed, with little regard for severe changes in direction; usually every 20-30 meters (Fig. 15). Their objective was apparently to dig directly to the perimeter. In several places heavy roots were bypassed and there was no evidence of partitioning of sections. None of the trenches were covered and only two small one-man side shelters were found in over 2000 meters of trenchline. The trenches averaged 24 inches wide and 4 feet deep, and in certain sections, this was expanded to widths of 4 feet, possibly to accommodate heavy weapons. As the main approach trenches neared the base, they narrowed and followed defensive terrain features more closely. When ended, each trench was crossed at right angles by a fighting or assault trench (Fig. 16). Each "T" contained multiple fighting positions which extended 30 feet on either side of the approach trench. Each fighting position accommodated one or two standing men, and was expanded or connected to other trenchline systems. In two of these type trenches were found barbed wire breaching poles made from three 3x10 foot poles tied together with bamboo strips. (Appendix F).

d. Supporting arms were quite effective against the trenchline closest to the base, especially where they had crossed the "T" with fighting holes. Several of these positions were heavily bombed, and

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FIG. 15 SERPENTINE APPROACH TRENCH

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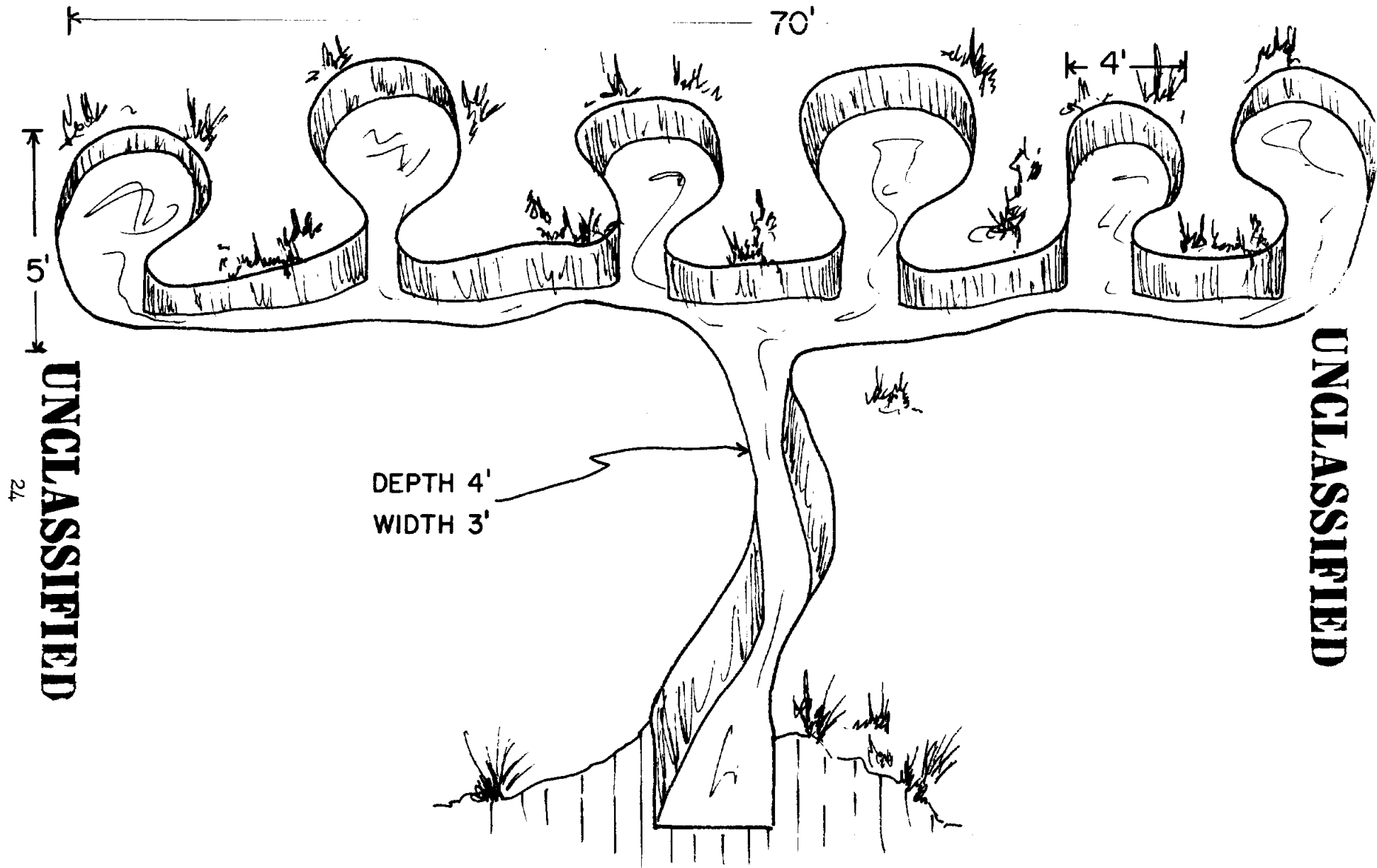


FIG. 16 ASSAULT POSITION

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were caved in and made ineffective as fighting positions. Hundreds of artillery craters were located throughout the area, ranging from 105mm to 175mm. In certain areas near the end of the system closest to the perimeter, bomb craters had completely obliterated the system for 50-60 meters. Many personal items such as canteens, helmets and packs were found in the trenchline. In a few areas napalm had successfully cleared openings in the scrub growth and thickets, however, its overall value remains doubtful. Again, the burned area was limited to a diameter of 30-40 feet, with little effect beyond the center. The NVA soldier did not live in these trenches. No evidence of living areas in the trench system was uncovered closer than the XD 8540 grid. An occasional AA site was connected to the main trench, but there was little evidence of a defensive plan to any of the battle trenches. The living trenches, however, contained multiple, mutually supporting AA sites.

8. (CMHA) SUPPORTING ARMS EMPLOYMENT AT LANG VEI (SEE APPENDIX G):

a. The old Special Forces camp at Lang Vei (XD 795362) was inspected to determine the extent of damage inflicted by US ordnance on the fortifications there. The camp lies astride Route 9, approximately 500 meters east of the new camp (XD 784357). When entered on 23 April, the camp was mostly rubble, having been subjected to a heavy bombardment during most of February and March. At least one B-52 strike had been employed across a portion of the camp causing widespread damage to the bunkers and obliterated the evidence of previously existing fortifications.

b. The fortifications in the camp were well constructed from steel engineer stakes, sandbags, reinforced concrete and heavy timber. They offered a higher silhouette than the NVA bunkers and were therefore more vulnerable to the effects of artillery and air ordnance. Each blockhouse (French origin) measured 6 feet per side, and consisted of 12 inches of reinforced concrete (Fig. 17). The roof was constructed of 4 inch I-beams spaced 12 inches apart which supported a 12 inch concrete slab overhead. Bunkers and other fortifications were interconnected by a trench which circled the outer perimeter of the camp. Living and fighting bunkers were supported by large logs and timbers, and extensive sandbagging had been used (Fig. 18). These bunkers held from 3 to 5 men, were 70 percent underground, and had fighting apertures facing the perimeter and the sides. These bunkers held up remarkably well under the heavy bombardment.

c. Artillery had heavily damaged much of the equipment and large structures above ground, but was generally ineffective against the lower silhouetted bunkers along the perimeter. The most recent clearing operation had destroyed much of the evidence of supporting arms against the NVA in the camp. No evidence of napalm was found. It is clear that in order to destroy a bunker of this type a bomb must hit the

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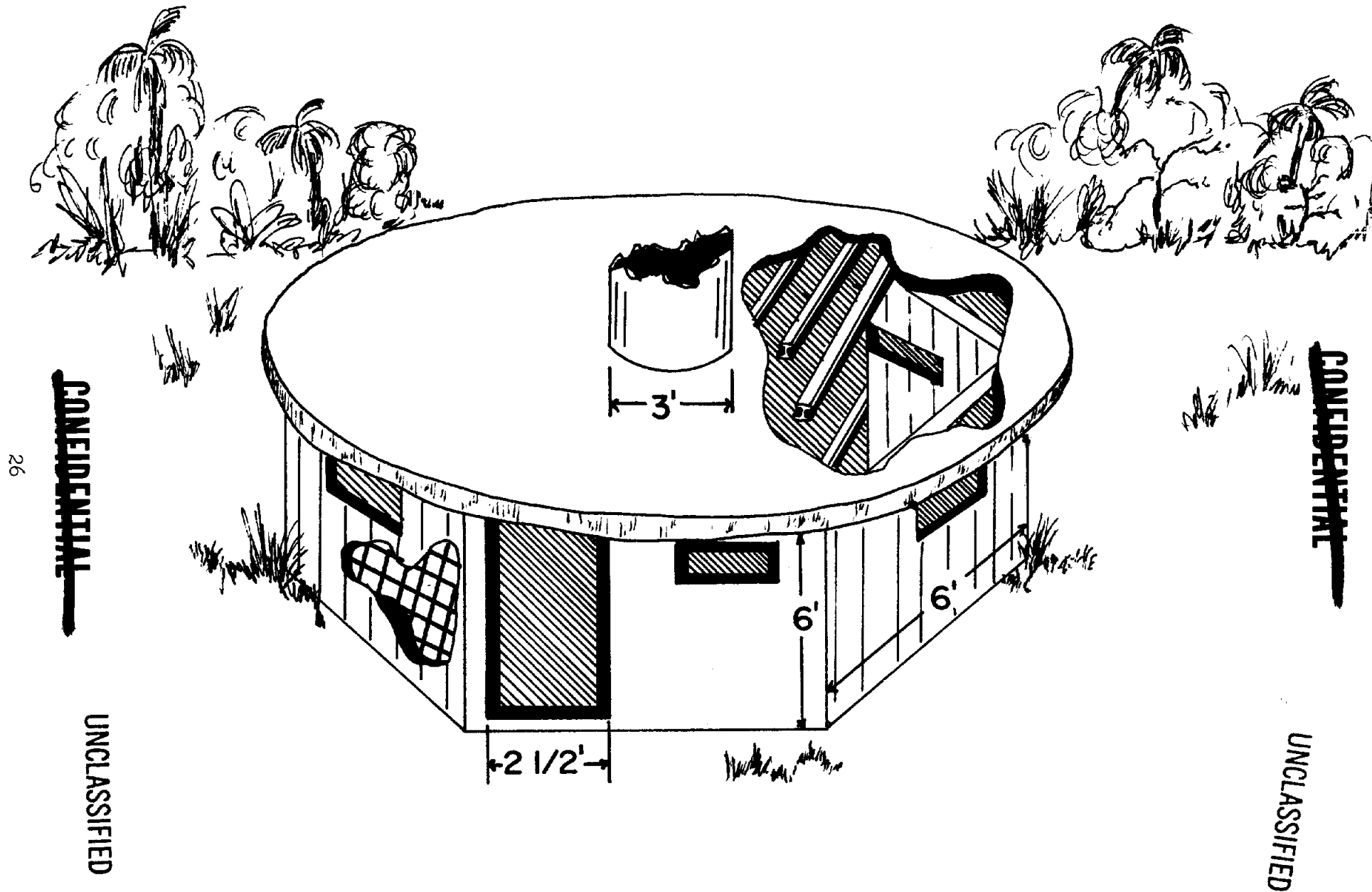


FIG. 17 CONCRETE BUNKER AT LANG VEI (FRENCH)

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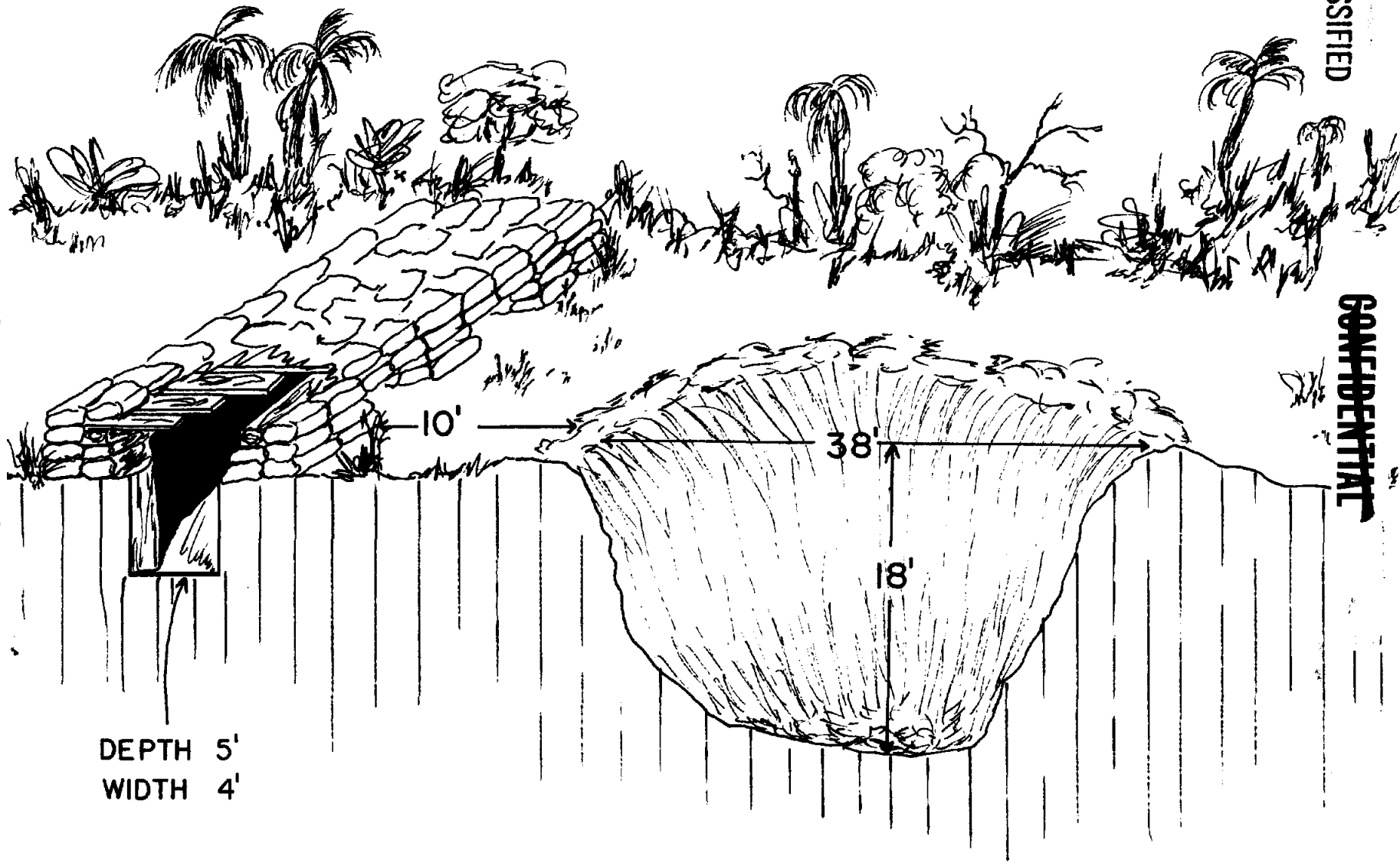


FIG. 18 PERIMETER BUNKER AT LANG VEI

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bunker, penetrate it, and explode on the inside. In many cases, it was apparent that the blast effect of near misses was cushioned by the soft laterite soil, causing minor damage to portions of the sandbags and leaving only a large crater. The effect of the bombs was similar to the heaving effect of the standard cratering charge. Debris was scattered over a wide area, but there was little fragment damage.

d. Bunkers outside of the crater itself were intact. Concussion damage was more likely to have been severe, but its effects are unknown. The area afforded an excellent target for air and artillery. Observation was excellent, and the camp was approachable from three directions. Artillery fire from Khe Sanh was extremely accurate, and there was considerable fragment damage to the exterior surface of the bunkers. The ordnance had not penetrated the bunkers or other fortified structures.

e. Of special interest were the bunker and adjacent craters shown in Fig. 19. The bunkers were of US construction and consisted of an 8x8x8 feet reinforced concrete "box" dug completely underground with 2 feet of overhead cover. The only entrance was a 28 inch culvert leading directly into the bunker from the top. Immediately adjacent to the bunker was a bomb crater 38 feet in diameter and 18 feet deep. The distance from the center of the bunker to the center of the crater was 28 feet. No damage to any portion of the bunker was found. There was no fracturing of the 10 inch walls on the inside, and no fragment damage to the entrance.

9. (CMHA) EMPLOYMENT OF RIOT CONTROL TEAR AGENT (CS):

a. On three occasions non-persistent CS was employed in an attempt to flush out or interdict enemy movement along major infiltration and supply routes leading to Khe Sanh. In each case the method of employment consisted of 3 visually controlled A4 aircraft, each carrying 4 MK20 smoke tanks which ignite on release, dispensing a vapor.

b. The first employment was on 3 February in the area along the river from XD 803470 to XD 808463. The aircraft were directed by a forward air controller (FAC). Each made 2 passes dropping 2 tanks per pass. Area coverage was 30 percent. Weather prohibited early morning employment during optimum atmospheric conditions. Delivery time was 1500, when a lapse condition existed. Most of the vapor dissipated rapidly into the air even though the agent was delivered from altitudes of less than 100 feet. F4 aircraft with napalm and 500 lb. high drag bombs were employed approximately 5 minutes after the agent had been delivered, in an attempt to destroy the troops as they evaded the effects of the gas and sought shelter elsewhere. No troops were observed leaving the area, and the follow-up airstrikes were directed to likely staging/living areas within the target box.

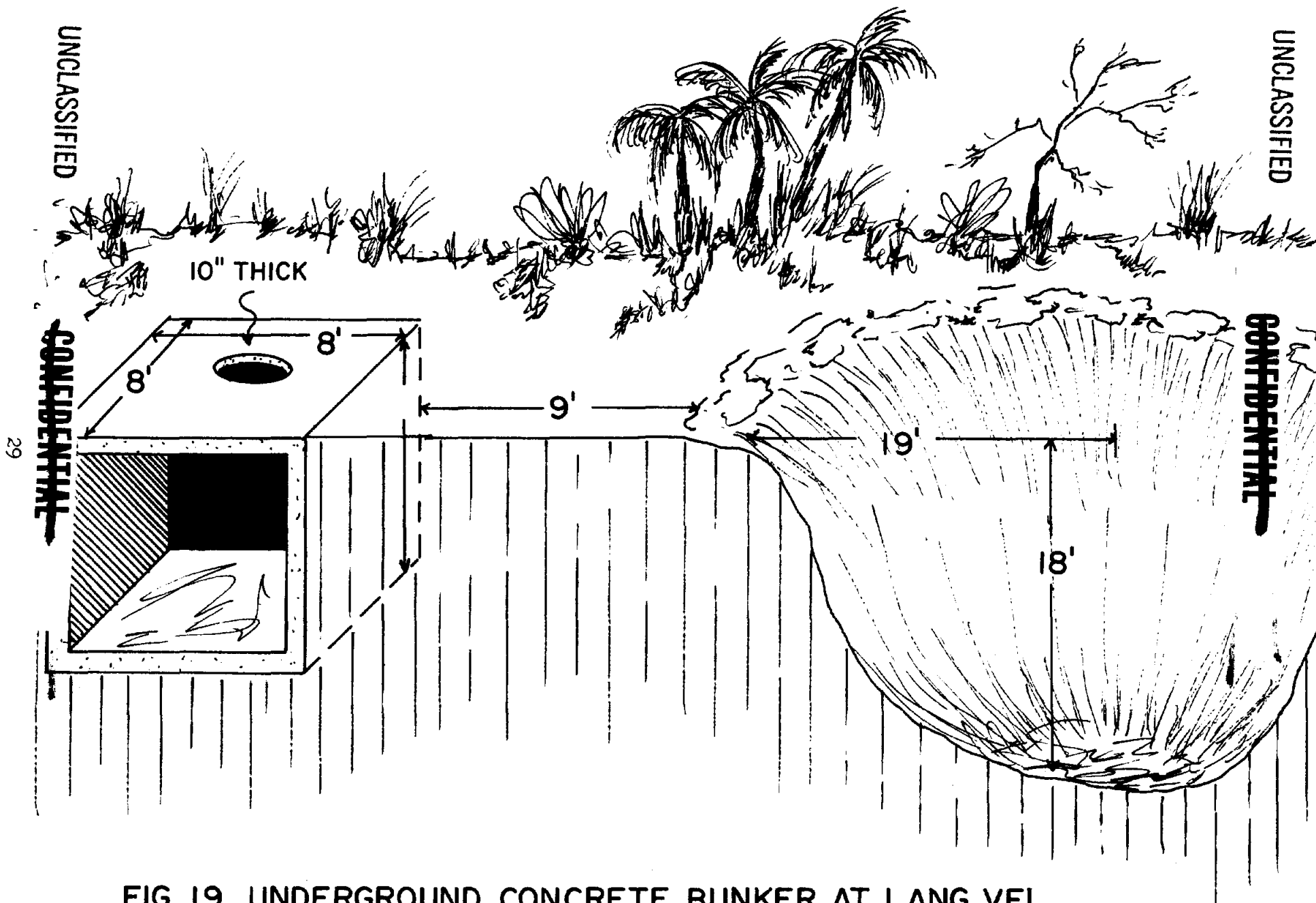


FIG. 19 UNDERGROUND CONCRETE BUNKER AT LANG VEI

c. Although no killed by air (KBA) were observed upon completion of the strike, subsequent sensor reports confirmed that evening that the usual infiltration route had changed considerably to avoid the area where the CS was employed. After 24 hours, infiltration down the stream bed returned to normal. A persistent CS powder would have been more desirable; however, it was not available.

d. On 5 February a similar method was used to interdict troop movement and destroy troops observed along the stream bed in the area bounded by XD 702469 - 714465 - 713462 - 702466. Weather again prevented employment until 1430 hours, and the same effects were observed. Aircraft heading was parallel to the stream, approximately 1/4 of the way up the slope on either side. Subsequent airstrikes employing napalm, 500 lb. high drag bombs and 5 inch Zuni rockets yielded two secondary explosions at XD 708464. The strike was not successful in interdicting troop movement. Sensor reports indicated the usual movement that night.

e. On 6 February, a third strike was placed at XD 811467, in the vicinity of a heavily used trail junction. The CS again billowed and was virtually ineffective. Aircraft with 500 and 2000 lb. bombs were directed against NVA bunkers and tunnel complexes on Hill 516 (XD 799460). The use of CS as a method of interdicting troop infiltration can be very effective if employed under the following conditions:

- (1) In the early morning, cool clear weather, relatively light winds and neutral or inversion atmospheric condition.
- (2) A persistent/powdered agent is made available for interdiction.
- (3) A vapor agent is made available for flushing the enemy from bunkers, trenches and fighting holes.
- (4) Employment is followed by immediate artillery/airstrikes employing VT/Firecracker/CBU antipersonnel munitions, napalm or extended fuze bombs ("daisy cutters").

f. It has been proven through interrogation and recovery of captured equipment that NVA troops at Khe Sanh were equipped with Soviet PK-1 (Chinese Type 66) Gas Masks. The mask consists of two pieces, an oral-nasal respirator and a set of goggles. The mask is effective in a CS environment, but tends to crack and become useless after exposure to moisture for any prolonged period.

g. There were no bunker complexes inspected that would have withstood the coordinated use of a CS munition. The living bunkers, although several feet underground, were nevertheless vulnerable to a settling type vapor through either the main entrance off the trenchline,

or the air vent located on the side opposite the entrance. After allowing for the gas to permeate the living bunker, follow-up aircraft with CBU type ordnance would provide the rapid area coverage necessary to exploit the effects of the agent.

10. (CMHA) USE OF NAPALM IN HIGH GRASS:

a. There was a tendency to overestimate the effects of napalm as a method of burning off dense elephant grass. It was found that only the area within a 50 foot diameter of the point of impact was sufficiently burned to provide tactical fields of fire, or observation of the ground. In uphill terrain the splashing was retarded and in areas where the terrain sloped away from the aircraft heading, the tendency was to overshoot the desired point of impact. In most cases the grass beyond the 50 foot circle was blackened only at the roots, while the tops remained green. Heavy early morning fog and occasional light rain kept most of the foliage damp which lessened the effects of the napalm.

b. The heat and suffocating effect of napalm were very effective against personnel in bunkers when it was delivered on the living bunker. Coordinated napalm air "slams" against the living bunkers, followed by VT/CBU ordnance against exposed troops, were excellent methods of destroying the living areas and enemy assault troops.

11. (CMHA) ATTACK OF BUNKER COMPLEXES:

a. To successfully attack and destroy an NVA bunker complex similar to the type encountered at Khe Sanh requires methodical, repetitive reconnaissance by aerial observers and photo interpreters, and coordination with cognizant Direct Air Support Center to insure target/ordnance matching and timely arrival of aircraft.

b. There was little evidence that the NVA lived in their trench-lines. Instead, large bunker and trench complexes were constructed adjacent to the main communications/fighting trench system. The living areas were located within 200 meters of the primary trenches, either in heavy grass and scrub brush, or under a canopy of trees. In all cases these living areas were well camouflaged and showed considerable care in placement and construction. It is of significance that the NVA soldiers often moved about freely in the main trench system during the day, but were not seen elsewhere. Consequently, many of the living areas went undiscovered. Movement from the living area to the forward trenches commenced during the early evening hours, and excavation continued throughout the night. By morning, few soldiers were observed remaining in the trenches.

12. (CMHA) FACTORS AFFECTING TARGET ACQUISITION:

a. In order to accurately assess the damage inflicted on the enemy

at Khe Sanh, it must be pointed out that the difficulties of target acquisition undoubtedly played a large role in determining the type and amount of ordnance employed in each case. Factors affecting target acquisition were grouped as:

- (1) The counter-surveillance screen of camouflage and frequent movement.
- (2) Utilization of adverse weather to cover large troop movements, trenching, and construction of fortifications.
- (3) The effect of mountainous terrain on ground observation.
- (4) The environment created by antiaircraft and automatic weapons fire against observation aircraft.
- (5) Limited observation aircraft assets.

b. If results were not observed, a prediction was made of the outcome of weapons employment and the probable effects of a given system versus a specific target. Weapons effects manuals address problems of damage within certain confidence intervals, relying on the assumption of normal distribution for fall of shot, Circular Error Probable (CEP) miss-distances for bombs, etc. In many cases however, weapons employment was based on intuition and experience. The requesting agencies relied on the intuition and experience of the observer, the FAC and the pilot in selection and delivery of ordnance.

c. The proven difficulty of locating and destroying a reveted artillery position was best illustrated by the example of causing damage sufficient to force evacuation of the piece for repair (defined as an F-Kill). The table below depicts the acceptable miss-distance to achieve an F-Kill on a 152mm artillery piece.

TABLE I

(U) Miss-Distance *

<u>WEAPON</u>	<u>ACCEPTABLE MISS-DISTANCE (feet)</u>
250 lb. MK 81	8
500 lb. MK 82	11
750 lb. MK 117	15
1000 lb. MK 83	16
2000 lb. MK 84	23

* Weapons effectiveness information is based on recently reconfirmed unclassified data from the Joint Munitions Effectiveness Manual (JMEM), the JCS approved data source for all effectiveness information.

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d. The significance of these small F-Kill miss-distances can be placed in perspective by consideration of the CEP for bombs delivered visually at 500 kts. in a 45 degree dive from various altitudes (Table II).

TABLE II(U) Bomb Drop Altitude vs CEP

<u>ALTITUDE (feet)</u>	<u>CEP (feet)</u>
4000	225
4500	252
5000	277
5500	307
6000	330
6500	355

e. Similarly for artillery:

TABLE III(U) Artillery CEP

<u>WEAPON</u>	<u>RANGE (KM)</u>	<u>OBSERVED FIRE (ft)</u>	<u>UNOBSERVED FIRE (ft)</u>
105mm	9	102	289
155mm	12	153	400
175mm	24	206	719

TABLE IV(U) Rounds Required for an F-Kill

<u>WEAPON</u>	<u>RANGE</u>	<u>OBSERVED ROUNDS</u>	<u>UNOBSERVED ROUNDS</u>	<u>WITHIN OBSERVATION</u>	<u>UNOBSERVED ROUNDS</u>
105mm	9	660	1000+	125	825
155mm	12	1000+	1000+	260	1000+
175mm	24	1000+	1000+	560	1000+

f. The foregoing is not intended to degrade the usefulness of weapons systems presently employed. Quite obviously, the magnitude of damage inflicted at Khe Sanh was completely unexpected by the enemy. The intent is to emphasize the extreme difficulty encountered in the successful attack of hard point artillery targets.

13. (CMHA) CONCLUSIONS:

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a. NVA Fortifications: From the compiled data of the various bunker complexes and trench systems at Khe Sanh, certain facts may be summarized:

- (1) Construction consisted of locally available materials.
- (2) Entrances to bunkers were kept as small as possible and were at right angles to the main axis of the bunker.
- (3) The most common bunker measured 4x6x4 feet and was rectangular-shaped with 18-24 inches of overhead cover.
- (4) Overhead cover consisted of logs covered with a grass matting and earth.
- (5) Camouflage was deliberate and detailed.
- (6) Bunkers had a low silhouette, and blended with the terrain and foliage.
- (7) Extensive booby traps were not encountered.
- (8) Bunker complexes were located on reverse slopes adjacent to trails and water sources.
- (9) Positions were mutually supporting and interconnected by trench systems or communications wire.
- (10) Trenches were serpentine-type, 2x4 feet, with directional changes every 20-30 feet.
- (11) Trench complexes were not used as living areas; they provided access to living areas and/or assault positions.
- (12) Antiaircraft and automatic weapons positions were integrated into the trench and bunker complexes for protection and to deny observation.
- (13) Small, individually camouflaged holes along trail networks indicated the presence of a large unit in the area.

b. Supporting Arms Effects: The supporting arms effort directed against the NVA fortifications in the Khe Sanh area was successful in driving the enemy from his entrenched positions. General comments concerning the effects of these supporting arms are summarized as follows:

- (1) The NVA bunker withstood anything but a direct hit by bombs or artillery.

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(2) Delay fuzing produced the best effects against bunker complexes; however, much of the ordnance penetrated too deeply before detonating in the soft soil.

(3) Quick fuzing was effective as a means of stripping away camouflage and exposing the position. It was not effective against bunker systems.

(4) Napalm was not effective as a defoliant over large areas.

(5) Artillery of 105 and 155mm was not effective in a bunker destruction role.

14. (CMHA) LESSONS LEARNED:

a. Avoid piecemeal expenditure of ordnance against scattered targets. When areas of high activity are located, isolate and expose them with stand-off fuzing, napalm and incendiary ordnance, then attack the position with the type and quantity of ordnance best suited for destruction.

b. Reduce delivery CEP by employing more observation aircraft, and using area type munitions such as the CBU and BLU series against personnel targets.

c. Deny the enemy the use of his bunkers and living areas through intensive observation exposure and CS contamination.

d. Utilize lapse or neutral atmospheric conditions for CS employment against personnel targets.

e. Emphasize surprise through random selection of high intensity areas of activity.

f. Increase delay fuzing sensitivity for soft soils.

g. Employ surprise fire during periods of reduced visibility.

h. Utilize incendiary munitions in lieu of napalm for exposing fortified areas in high grass.

i. Use observed fires whenever possible.

j. Thoroughly search NVA trench systems for living bunkers prior to expending large quantities of ordnance on the trenches alone.

k. Consider selection of a delivery system which will place persistent CS in selected portions of the trenchline to deny its use as an attack position, or force a new system to be constructed.

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l. The aerial observer (AO) must be permitted to conduct a methodical reconnaissance of every suspected position to insure positive location and identification of living areas. Once they have been identified they must be further exposed and reduced. Pilot accuracy increases greatly when he is able to visually identify and follow his target, and aerial observers should encourage the pilots of supporting aircraft to make several dummy runs from different headings until the pilot sees the target. When hostile fire prevents low level observation or dummy runs, the AO and the supporting aircraft pilot should pick a prominent reference point close to the target to be used in conjunction with the marking smoke.

m. Initial runs should be made with hard ordnance employing "daisy cutter" fuze, or napalm. Artillery white phosphorus can be used to burn away the grass or mark the entire area. The important point is to first expose the target by destroying the surrounding vegetation, then conduct systematic attacks against the bunkers employing heavy artillery and air ordnance with delay fuzing.

ll Appendices

- A. Individual Living/Fighting Holes
- B. Unit Bivouac Hasty Position
- C. Antiaircraft Positions
- D. Hilltop Defensive Positions
- E. Fortified Living Area
- F. Assault Trench Complex
- G. Supporting Arms Damage at Lang Vei
- H. Napalm Damage in High Grass
- I. Defensive Bunker Complex
- J. NVA Trench Complex and Fortifications
- K. Source Material

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INDIVIDUAL LIVING/FIGHTING HOLES

DATE: 27 May 1968

LOCATION: XD 851328

DESCRIPTION: Two 3x6x4 foot individual shelters covered with banana logs, leaves and earth.

APPENDIX A

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A-1 Individual Shelter

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A-2 Individual Shelter

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UNIT BIVOUAC HASTY POSITION

DATE: 27 April 1968

LOCATION: XD 855322

DESCRIPTION: 3x2 foot hasty sleeping and fighting hole. Part of a complex found under heavy canopy.

APPENDIX B

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B-1 Hasty Positions

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ANTIAIRCRAFT POSITIONS

DATE: 27 April 1968

LOCATION: XD 847317 and 853309

DESCRIPTION: Two groups of three 12.7mm
Antiaircraft positions on ridgeline.

APPENDIX C

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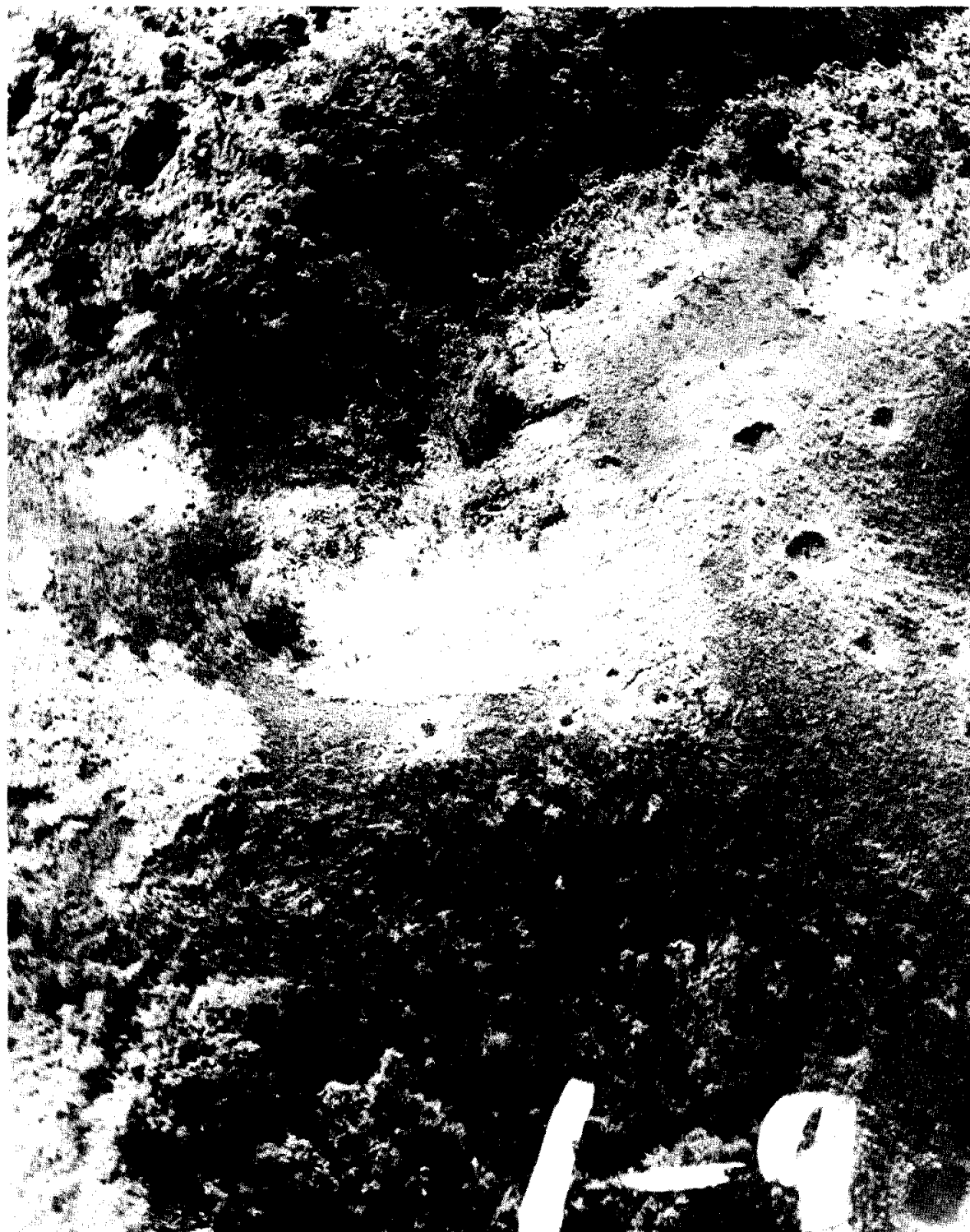
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C-1 Two AA Positions

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C-2 Triangular AA Position with Bomb Crater

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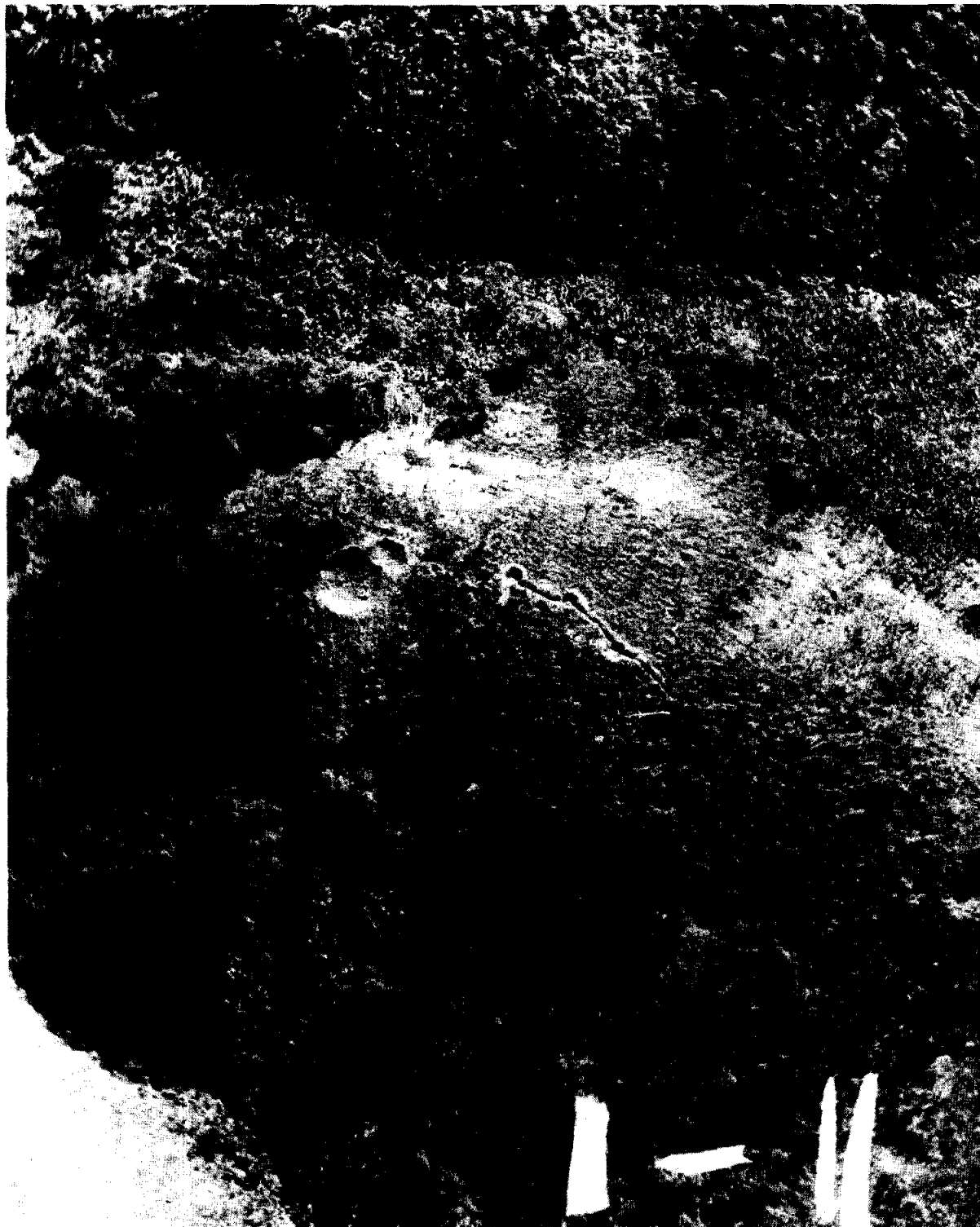
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C-3 Linear AA Position

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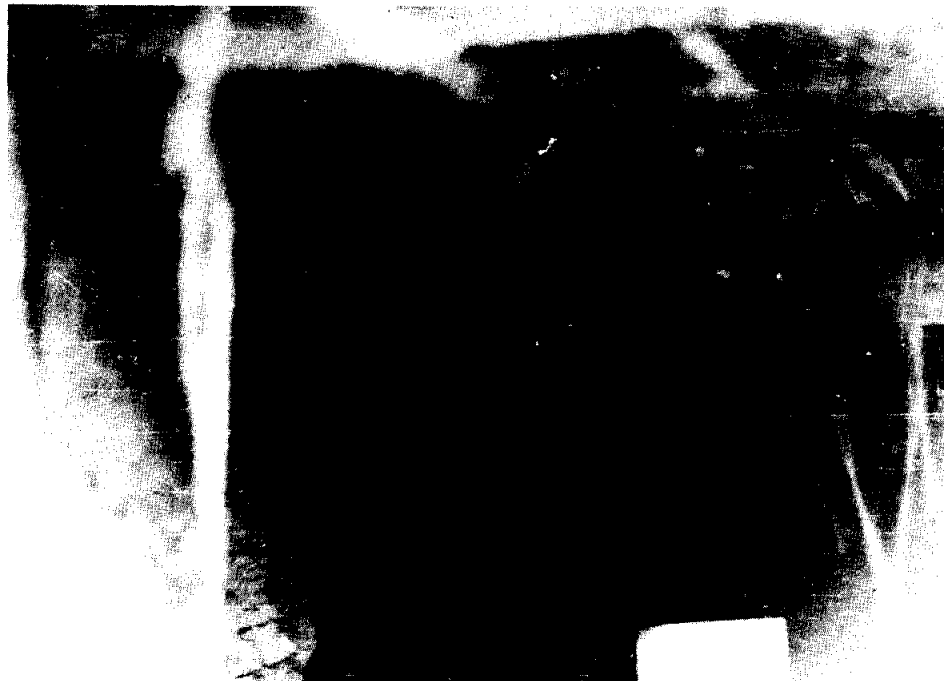
C-4 Linear AA Position

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C-5 Interior of AA Position



C-6 Interior of Living Bunker

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C-7 Connecting Trench

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UNCLASSIFIED



C-8 AA Pedestal Mount



C-9 Living and Storage Bunker

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UNCLASSIFIED



C-10 Personnel Shelter



C-11 Command Bunker

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UNCLASSIFIED



C-12 Connecting Trench

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HILLTOP DEFENSIVE POSITIONS

DATE: 26 April 1968

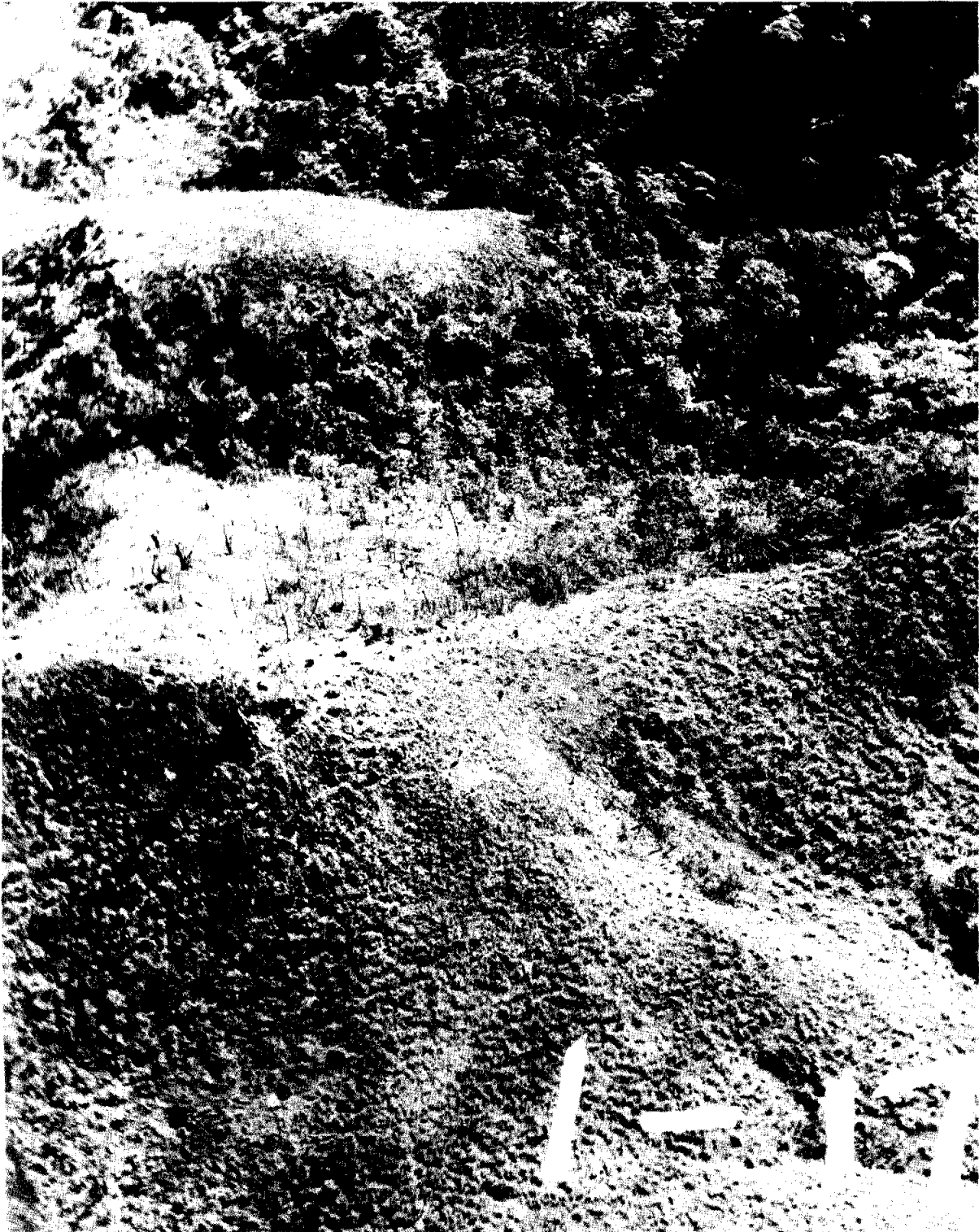
LOCATION: XD 828321

DESCRIPTION: NVA defensive position on Hill 663 and
damage caused by airstrikes and artillery

APPENDIX D

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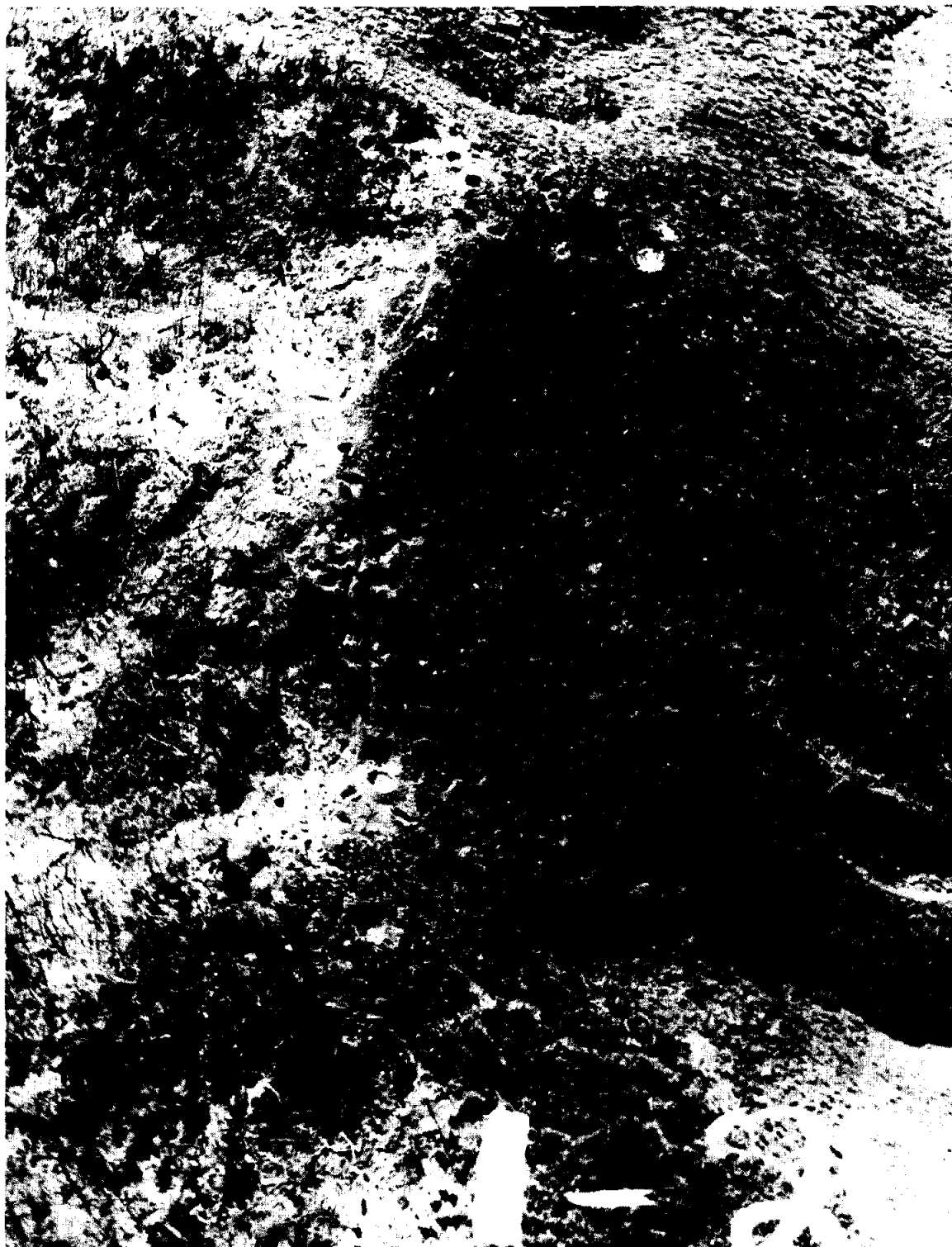
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D-1 Defensive Positions

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D-2 Bomb Damage

UNCLASSIFIED

UNCLASSIFIED



D-3 Bomb Damage

UNCLASSIFIED

UNCLASSIFIED

FORTIFIED LIVING AREA

DATE: 6 May 1968

LOCATION: XD 856406 and 858407

DESCRIPTION: Camouflaged NVA fortified living area
in vicinity of French plantation, and
damage caused by airstrikes.

APPENDIX E

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E-1 Fortified Living Area in Plantation

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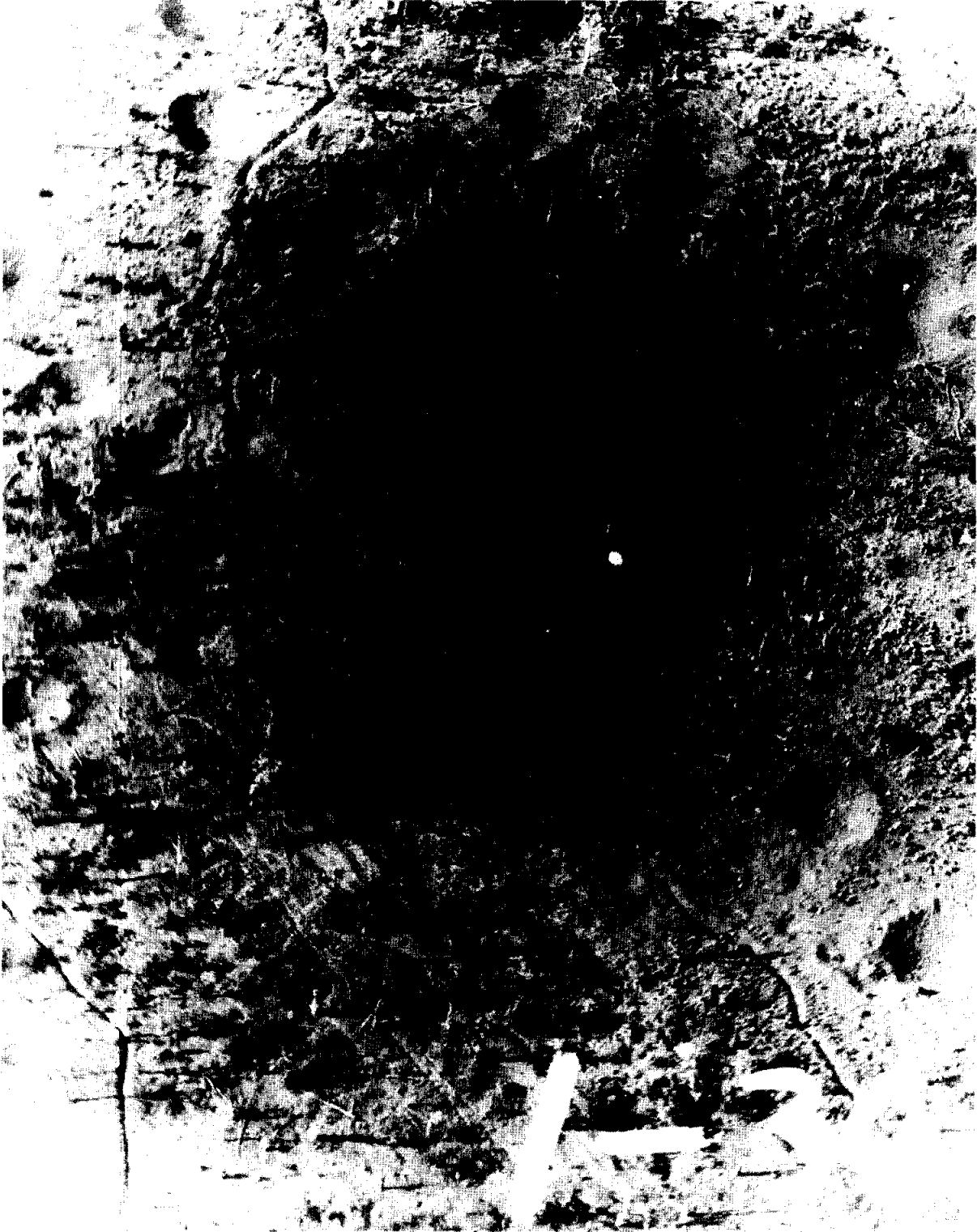
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E-2 Trenches Leading to Living Area

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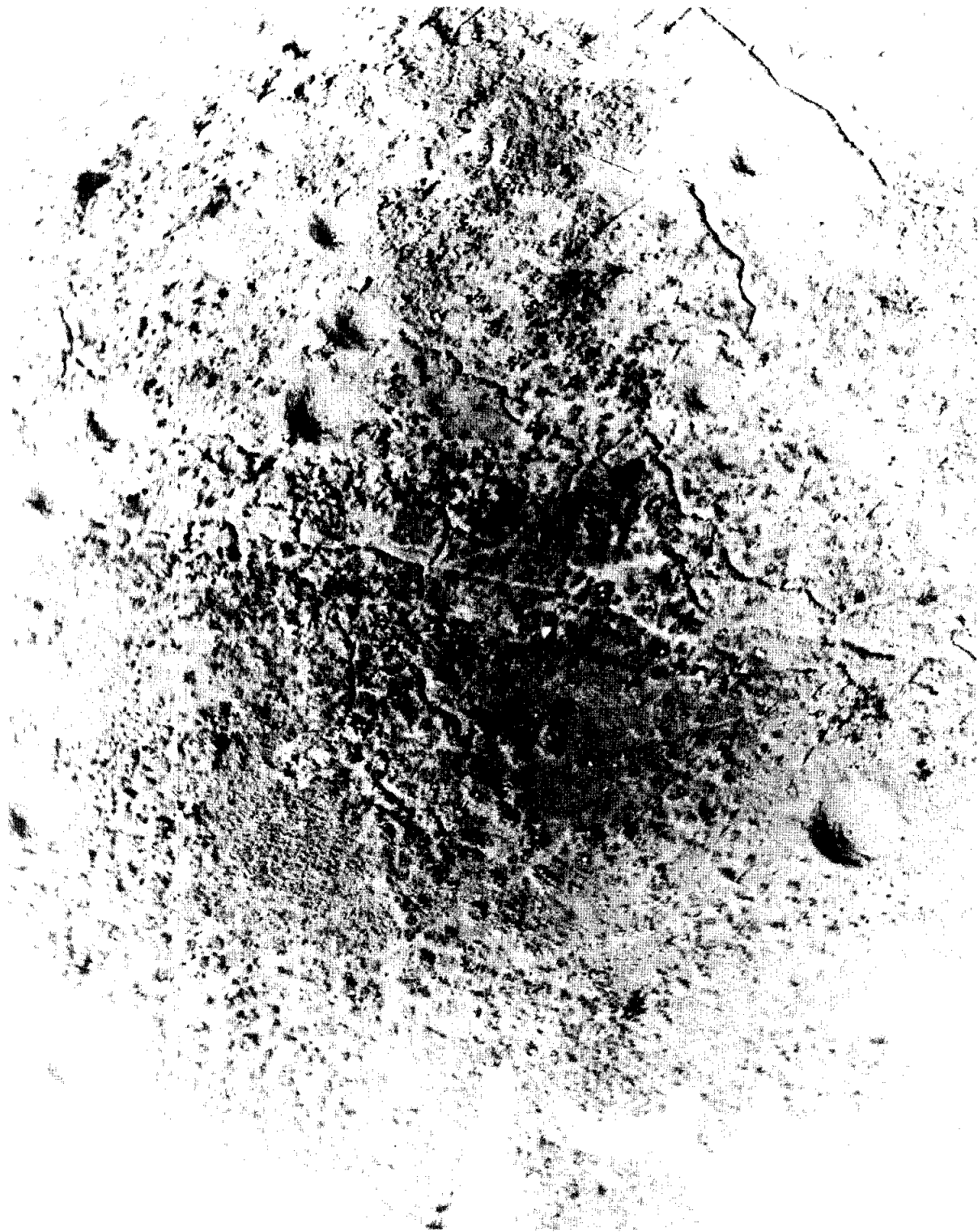
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E-3 Trenchline Parallel to Road

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E-4 Living Bunker Complex

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UNCLASSIFIED



E-5 Access Trench to Living Area

UNCLASSIFIED

UNCLASSIFIED



E-6 Crater Damage



E-7 Crater Damage

UNCLASSIFIED

UNCLASSIFIED



E-8 Damage to Living Area

UNCLASSIFIED

UNCLASSIFIED



E-9 AA Position Protecting Living Area



E-10 Mortar Pit Protecting Area

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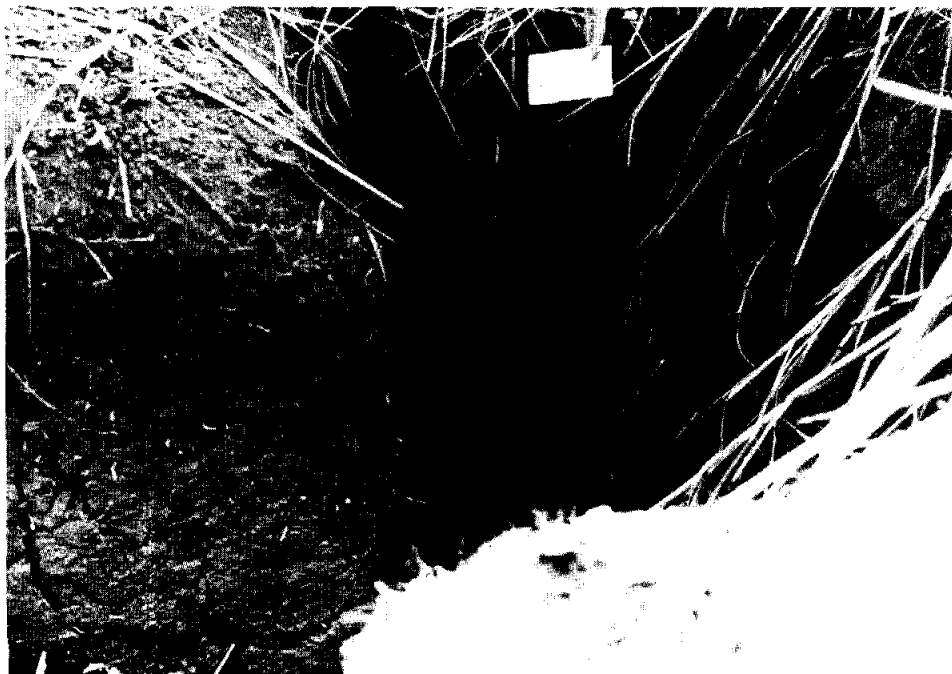
E-11 Bunker Materials



E-12 Bunker Materials

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E-13 Living Bunker



E-14 Living Bunker

UNCLASSIFIED

UNCLASSIFIED



E-15 Living Bunker Complex

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ASSAULT TRENCH COMPLEX

DATE: 8 May 1968

LOCATION XD 848405 to XD 850415

DESCRIPTION: Assault and communications trench complex leading from living areas to perimeter of Khe Sanh Base.

APPENDIX F

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F-1 Portion of Assault Trench System

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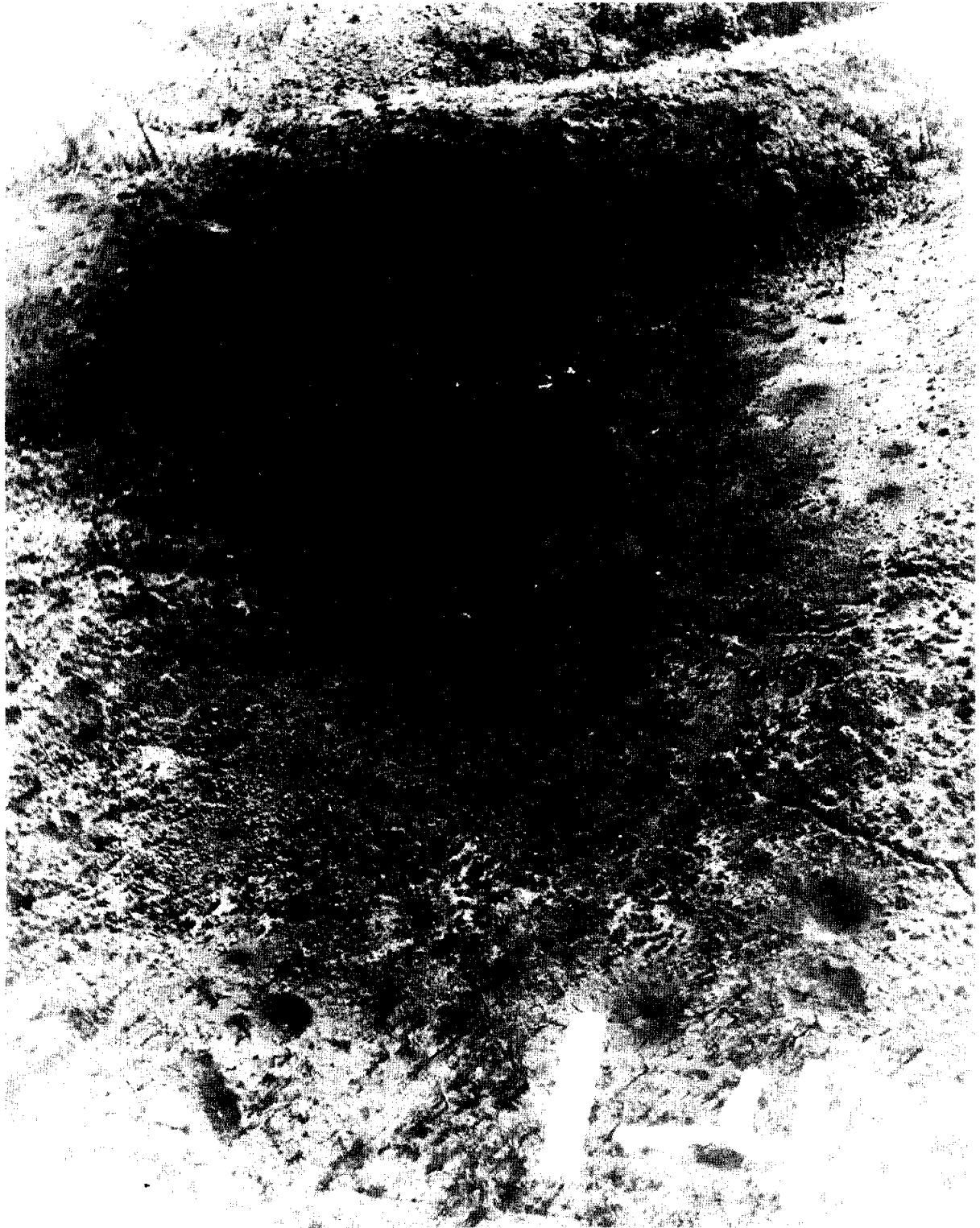
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F-2 Terrain Southwest of Base

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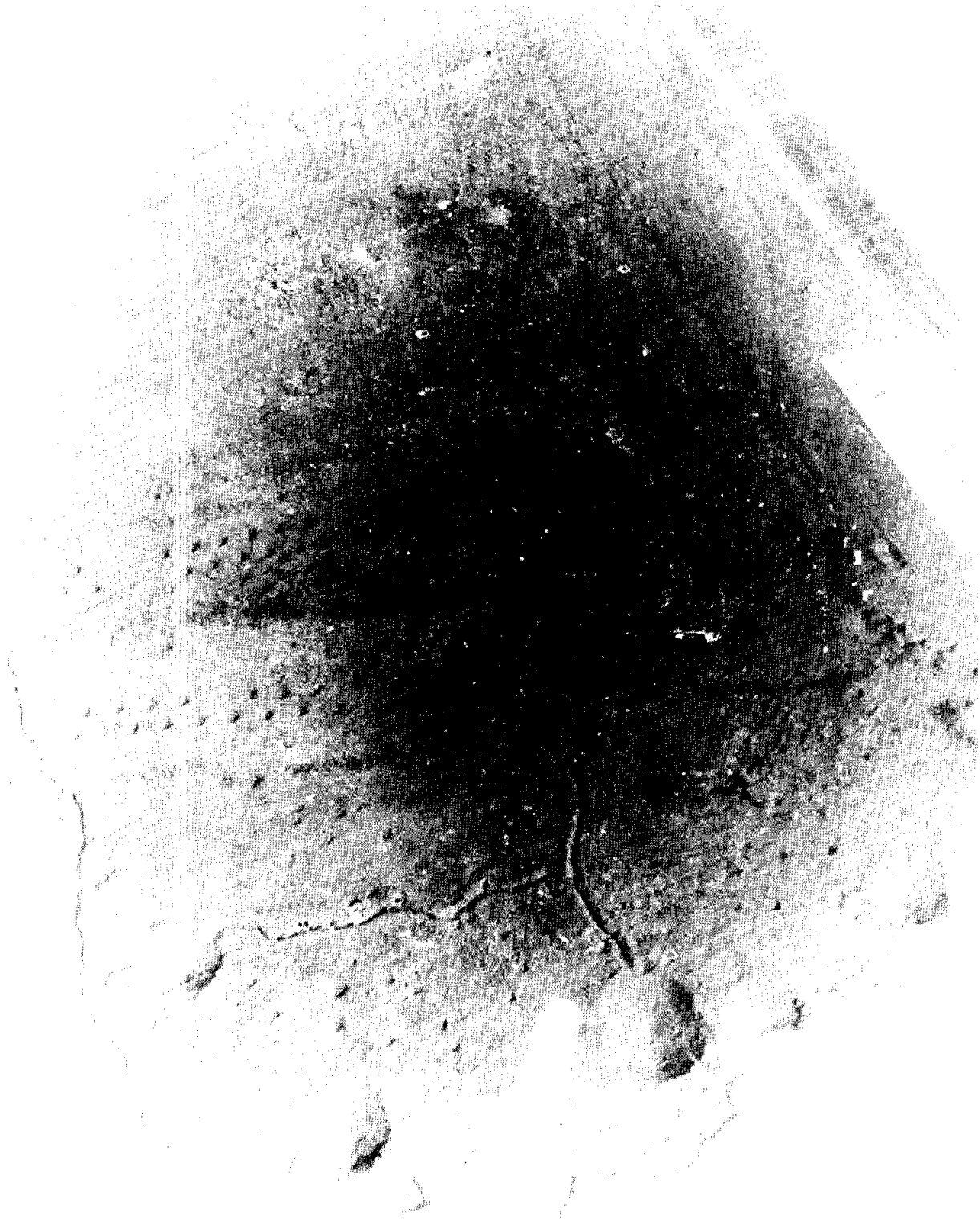
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F-3 Portion of Assault Trench System

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UNCLASSIFIED



F-4 Assault Trenches on East Perimeter

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F-5 Assault Trenches on East Perimeter

UNCLASSIFIED

UNCLASSIFIED



F-6 Trenchline Through Plantation

UNCLASSIFIED

UNCLASSIFIED



F-7 T-Shaped Assault Position

UNCLASSIFIED

UNCLASSIFIED



r-8 T-Shaped Assault Position

UNCLASSIFIED

UNCLASSIFIED



F-9 Complex East of Base

UNCLASSIFIED

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F-10 Terrain East of Base



F-11 Protective Hole in Trenchline

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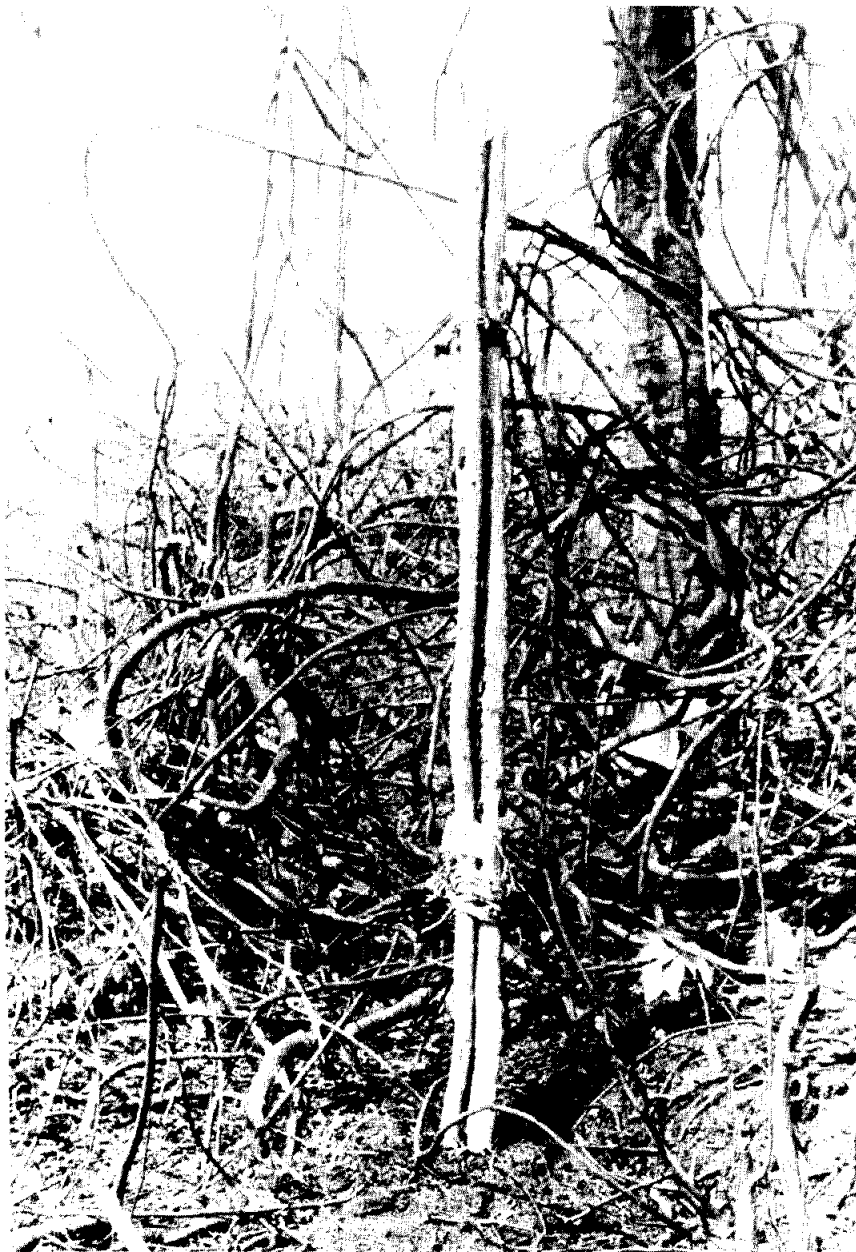
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F-12 Assault Trenchline

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F-13 Barbed Wire Breaching Pole

UNCLASSIFIED

UNCLASSIFIED

SUPPORTING ARMS DAMAGE AT LANG VEI

DATE: 23 April 1968

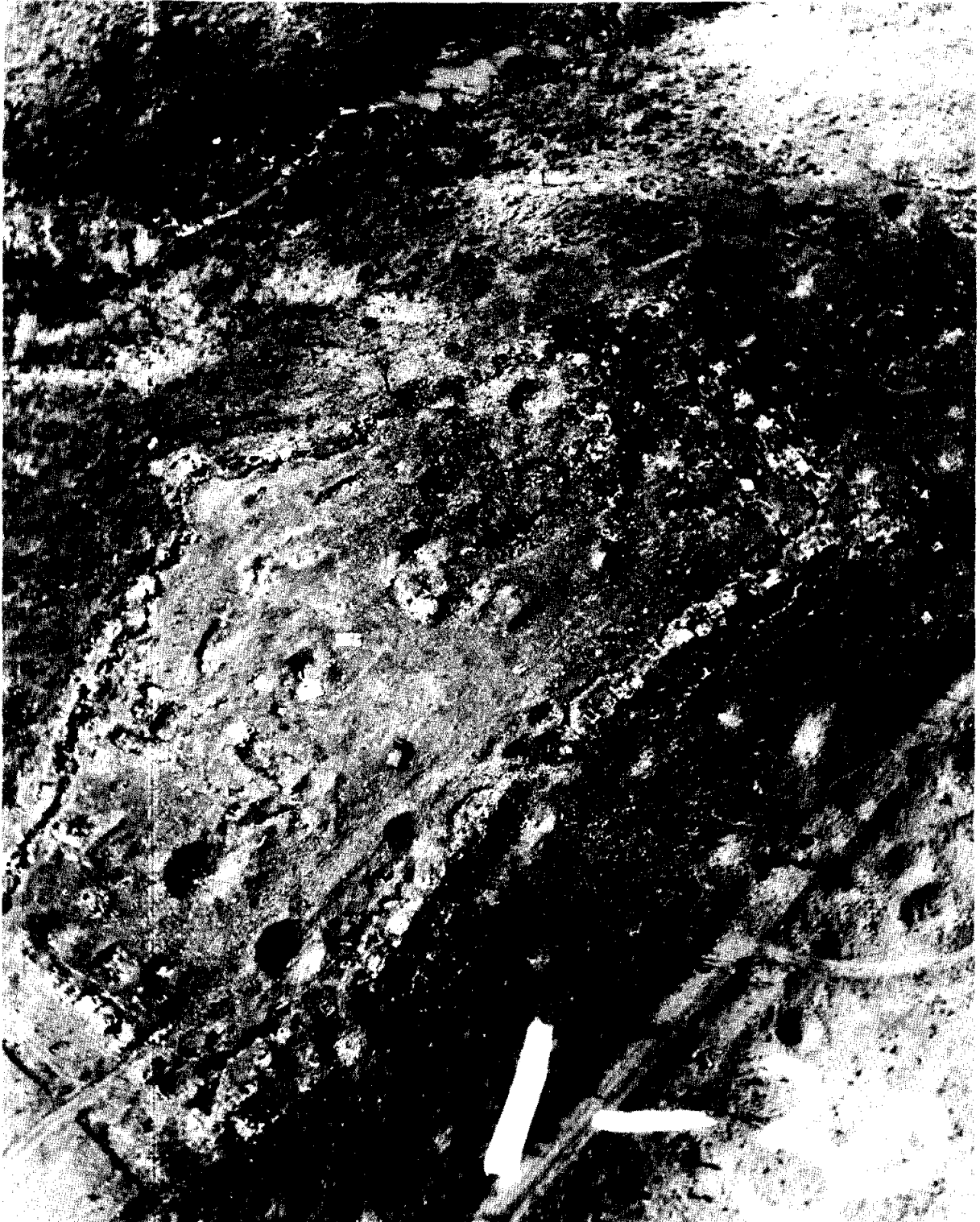
LOCATION: XD 795362

DESCRIPTION: Air and artillery damage to Special Forces
Camp at Lang Vei

APPENDIX G

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G-1 Lang Vei

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UNCLASSIFIED

NAPALM DAMAGE IN HIGH GRASS

DATE: 27 April 1968

LOCATION: XD 846374 and XD 850412

DESCRIPTION: Damage to grass and heavy brush by single tank of napalm. Diameter of burned area - 20 meters.

APPENDIX H

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H-1 Napalm Damage in Elephant Grass



H-2 Napalm Damage in Brush

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DEFENSIVE BUNKER COMPLEX

DATE: 28 April 1968

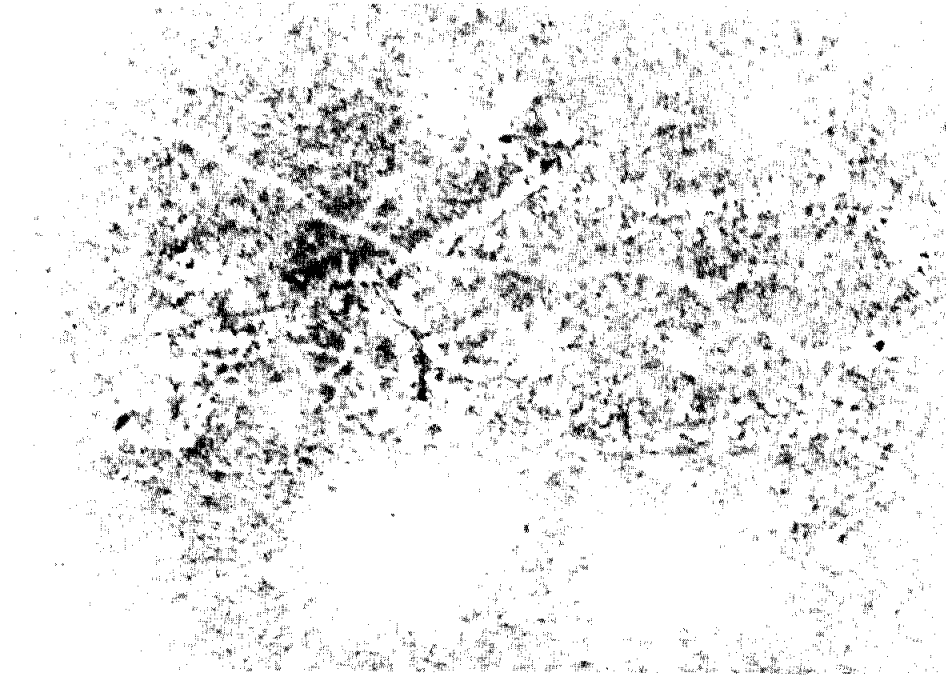
LOCATION: XD 856370

DESCRIPTION: Estimated Battalion defensive position on hilltop. NVA have used bomb craters as bunkers. Complex has mutually supporting positions and prepared fighting holes.

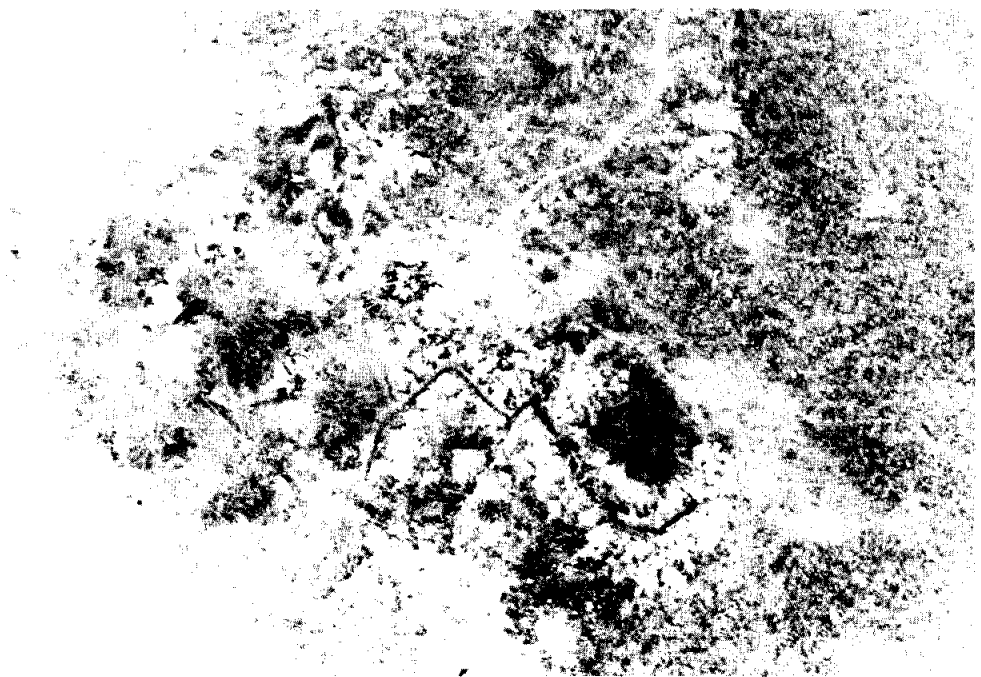
APPENDIX I

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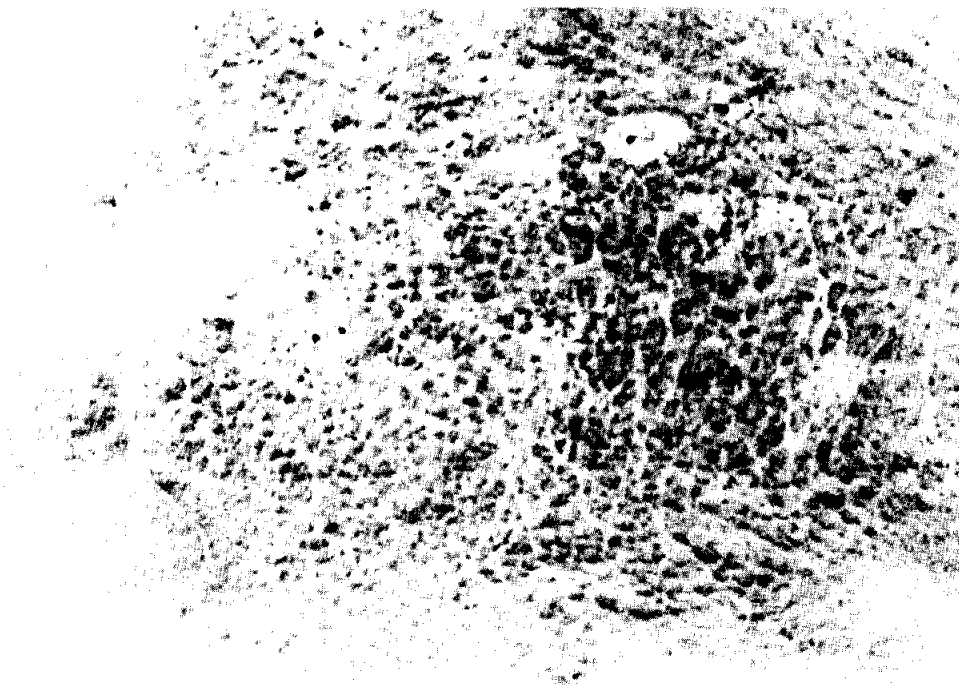
I-1 Battalion Defensive Position



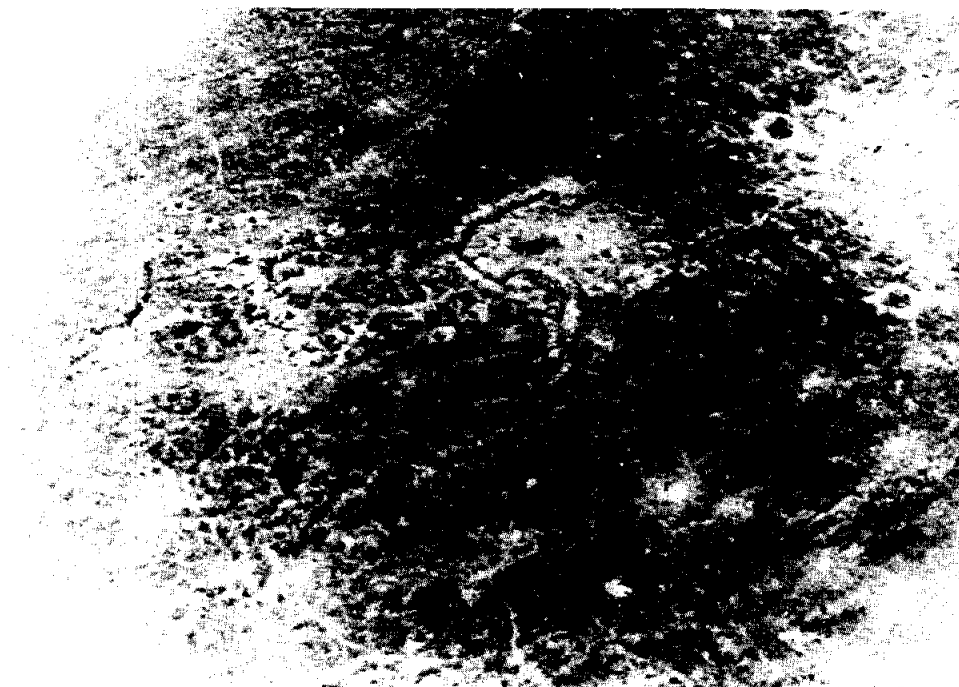
I-2 Interconnecting Positions

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I-3 Bunkers in Bomb Craters



I-4 Fortified Battalion Position

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UNCLASSIFIED

NVA TRENCH COMPLEX AND FORTIFICATIONS

DATE: 15 May 1968

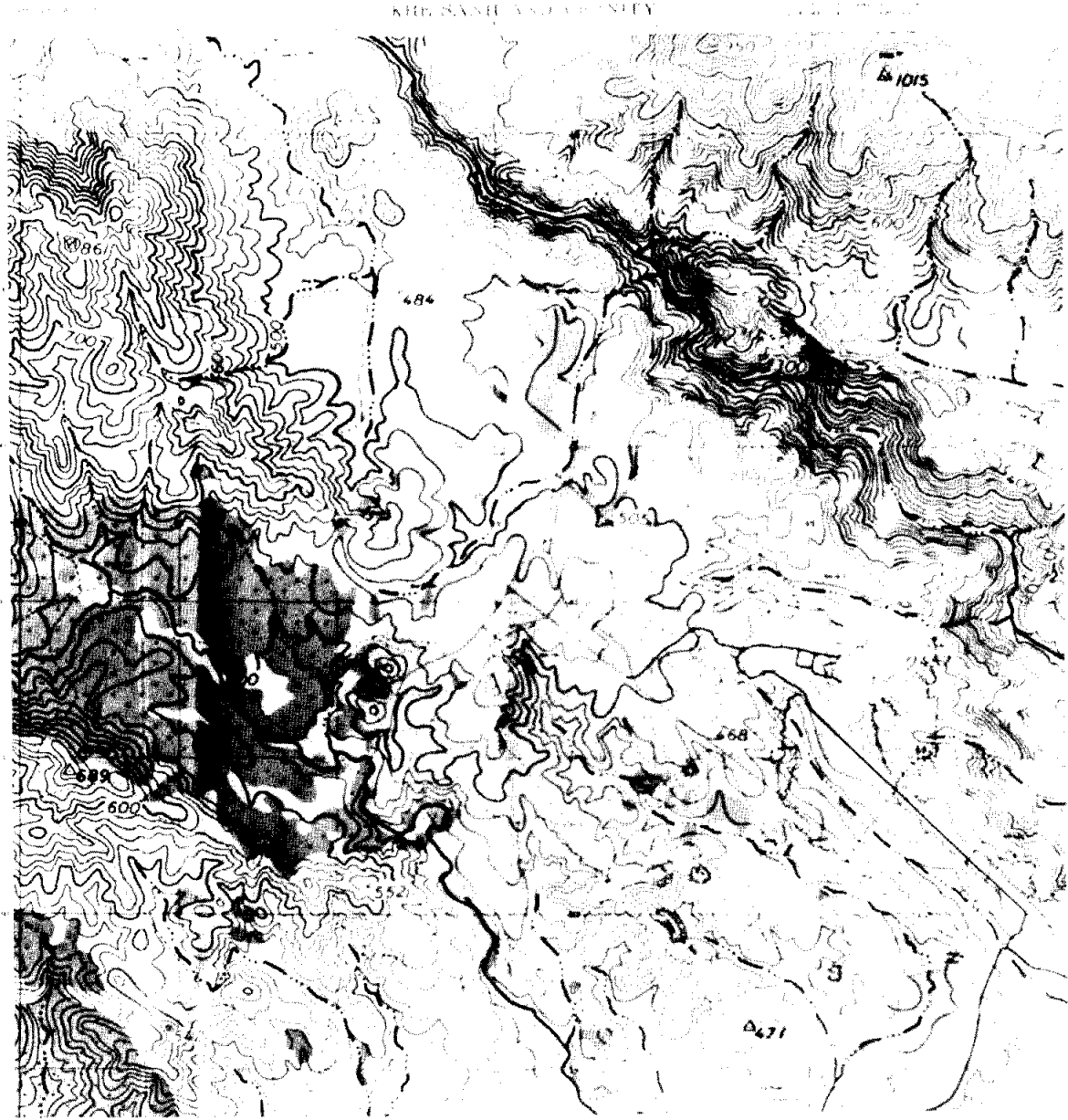
LOCATION: South of Khe Sanh Base

DESCRIPTION: Schematic drawing of the trenches prepared by the NVA from January to March 1968. Plots are based on aerial photo interpretation.

APPENDIX J

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J-1

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SOURCE MATERIAL

APPENDIX K

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SOURCE MATERIAL

1. Analysis of Enemy Positions at Khe Sanh and Evaluation of Effectiveness of Weapons Systems Against Enemy Fortifications Study conducted and published by the 3rd Marine Division, 29 May 1968.
2. A Pictorial Study of VC/NVA Rocket Artillery, Headquarters MACV, ACoFS, J2, 14 September 1962.
3. Handbook for United States Forces in Vietnam. DOD GEN 25 DA Pam 360-521/NAVPERS 15222/AFP 190-1-2/NAVMC 2612.
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