FM 18-24

WAR DEPARTMENT FIELD MANUAL

TANK DESTROYER PIONEER PLATOON

WAR DEPARTMENT . NOVEMBER 1944

WAR DEPARTMENT FIELD MANUAL

FM 18-24

TANK DESTROYER

PIONEER PLATOON

WAR DEPARTMENT · NOVEMBER 1944

United States Government Printing Office
Washington: 1944

WAR DEPARTMENT,

WASHINGTON 25, D. C., 1 NOVEMBER 1944.

FM 18–24, War Department Field Manual, Tank Destroyer Pioneer Platoon, is published for the information and guidance of all concerned.

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

T of Opns (2); All SvC(2); Depts(2); Island C (2); Base C (2); Def C (2), Sectors (2), Subsectors (2); Base Sectors (2); HD (2); B 18 (1); R 18 (1); Bn 7, 18 (5), except I Bn 18 (20).

I Bn 18: T/O & E 18–25.

For explanation of symbols, see FM 21–6.

CONTENTS

Section I
GENERAL

1. Scope
This manual covers the tactical employment of the self-propelled tank destroyer pioneer platoon. It is designed to be used as a guide only and does not provide inflexible rules. All commanders must be encouraged to solve each situation according to the various factors involved.

2. Equipment
The pioneer platoon is organized and equipped to accomplish small construction and demolition tasks. The text and illustrations contained herein are based on tables of organization and equipment in effect at the date of writing. These tables may change at any time; however, the methods and principles described in this manual will still be applicable.

3. Mission
a. The pioneer platoon has two general missions:

(1) To prevent the movement of the battalion from being delayed by natural or artificial obstacles.

(2) To impede or canalize the movement of the enemy by the creation of obstacles.

b. Quickly executed field expedients, rather than extensive works or improvements, are the normal tasks assigned the platoon.

Note. For military terms not defined in this manual see TM 20–205.

c. The personnel of the pioneer platoon are trained to accomplish many tasks, some of the more common being—

Strengthening bridges.
Improving fords.
Making minor road repairs.
Clearing road blocks.
Making passages through mine fields.
Neutralizing booby traps.
Assisting in the preparation of gun positions.
Improving fields of fire.
Constructing road blocks.
Increasing the effectiveness of natural obstacles.
Laying or removing hasty mine fields.
Performing limited demolitions.

d. In addition to the above tasks, they are also trained to fight. They must know their weapons and be able to use them. At times, it may be necessary to fight in order to accomplish the primary mission; in emergencies, the platoon may be called on to cover by fire obstacles it has prepared or to reinforce the small arms fire of other ground troops.

Section II

PIONEER RECONNAISSANCE

4. General

Selected members of the pioneer platoon usually accompany elements of the reconnaissance company on route reconnaissance. The reconnaissance elements report the location of the roads, bridges, obstacles, and similar items; the members of the pioneer platoon report the condition of these items. All obstructions are investigated and reported to the reconnaissance company commander.

5. Missions

a. Some of the more common technical matters to be investigated and reported by pioneer reconnaissance elements are enumerated in the following paragraphs. These lists are to be used as guides and should be modified as experience warrants.

b. ROADS (FM 5–10). (1) Capacity, including possible effects of rain or snow. Can the road support the heavy vehicles of the battalion under all probable conditions?

(2) Obstacles and an estimate of the work required to reduce them (FM 5–30).

(3) Wood, gravel, rock, or other materials in the vicinity which could be used to repair the road.

(4) By-passes around obstacles if the road cannot be cleared or repaired in a reasonable length of time.

c. BRIDGES (FM 5–10). (1) Construction,

to determine the weight the bridge will bear. Bridge cards (par. 49) will be of assistance.

(2) Conditions of the approaches, to determine whether or not they can be used safely by the vehicles of the battalion.

(3) Repairs needed to the bridge or the approaches before the battalion can safely travel on it. (sec. XI).

(4) Materials in the vicinity which may be used for repairs.

(5) Presence of demolitions and booby traps and an estimate of the work required to neutralize them. This mission is especially important in territory which has been occupied by the enemy.

(6) Possible effect of a swollen stream or a heavy rain on the bridge and its approaches.

(7) By-passes that may be used even though the bridge will carry the battalion; enemy action or weather might render the bridge impassable before the battalion has used it.

(8) Time and material needed to destroy the bridge in the event this action should later become necessary (sec. XVI).

d. FORDS. (1) Approaches to ford sites, to determine whether or not they will support the vehicles of the battalion. If possible, the approaches should be perpendicular to the stream for at least fifty yards and should provide cover and concealment for the vehicles if there is any possibility of enemy observation. The exit need not be exactly opposite the entrance but may be a distance up or down the stream.

(2) Depth of the water in relation to the fordability of the vehicles of the battalion (par. 38).

(3) Condition of the stream bed to determine

whether or not it will bear the vehicles of the battalion.

(4) Work necessary to prepare the approaches and the stream bed for use (par. 38).

(5) Materials in the vicinity which can be used for necessary repairs.

(6) Possible effect of changing weather conditions on the stream bed and approaches.

e. CROSS-COUNTRY ROUTES. (1) All barriers to the movement of the battalion such as wooded areas, soft ground, streams, mined areas, traps, etc.

(2) Work required to make the route passable for all vehicles of the battalion.

(3) By-passes around any barriers requiring an excessive amount of work to reduce.

(4) All opportunities to impede enemy attacks, such as the possibilities of mining or constructing obstacles in likely avenues of approach.

f. MINED AREAS. (1) Location and extent of mined areas.

(2) The presence of booby traps in and around the mine fields.

(3) An estimate of the work necessary to clear a path through the mined area or the possibility of by-passing the mine field (sec. XIV).

6. Road and Bridge Guards

a. The capacity of bridges, fords, and other critical road sections is substantially increased and the required maintenance greatly reduced by controlling the speed and interval of vehicles at these points.

b. When tank destroyer vehicles cross points

which have a capacity equal to or only slightly greater than the weight of the vehicles, the maximum speed should be five miles per hour; the interval between vehicles should be at least 50 yards. A constant speed should be maintained.

c. Bridge guards should be stationed at critical points to enforce orders necessary for safe passage. The pioneer element of the reconnaissance party reports the number and locations of guards needed.

7. Pioneer Reconnaissance Reports

a. To be of value, the information secured by pioneer reconnaissance elements must be returned to the appropriate headquarters in sufficient time to be used. This information must be clear, concise, and accurate. Information obtained by pioneer reconnaissance will ordinarily be incorporated into the regular reconnaissance report.

b. A common means of reporting information is by overlays on maps or aerial photos to show the location of roads, bridges, mined areas, and other items. Notes on technical information may be placed on the overlays. When maps are not available, sketches may be used. An accurate sketch can be made by the use of a compass and the odometer of a vehicle.

c. To insure against omission of important details, forms may be prepared for reconnaissance. Forms cannot be prepared in advance to cover all situations, nor will they always be available in the field. FM 5–6 gives guides for reconnaissance. Figures 2 and 3 show sample forms for reconnaissance.

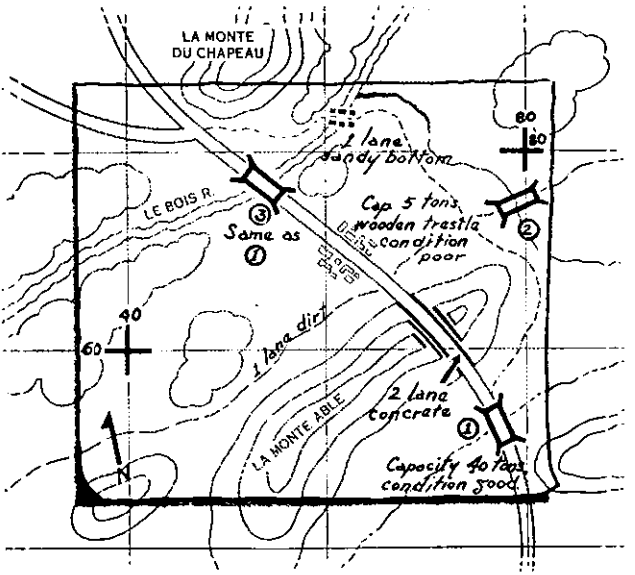


Figure 1. Information reported by means of a sketch.

DATE _____ ROAD DESCRIPTION

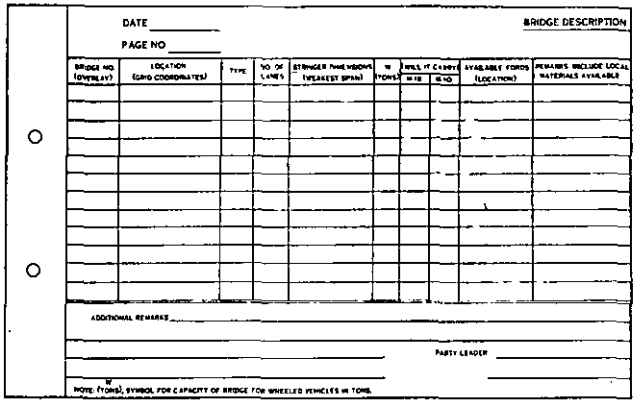
PAGE NO. _____

LOCATION FROM	(COORDINATES) TO	DISTANCE IN MILES	NO. OF LANES	SURFACE (TYPE)	DRAINAGE (GOOD, FAIR, ETC.)	REMARKS (INCLUDE PROBABLE CONDITIONS AFTER RAIN)

ADDITIONAL REMARKS (INCLUDING MAP REFERENCE, NAME, SCALE, DATE) _____

PARTY LEADER _____

Figure 2. A form for reporting road information.


DATE _____ BRIDGE DESCRIPTION

PAGE NO _____

BRIDGE NO. (OVERLAY)	LOCATION (GRID COORDINATES)	TYPE	NO. OF LANES	STRINGER TIMBERS (LEAKEST SPAN)	W (TONS)	WHEEL IT CARRIES		AVAILABLE FORDS (LOCATION)	REMARKS INCLUDE LOCAL MATERIALS AVAILABLE
						M-18	M-10		

ADDITIONAL REMARKS _____

PARTY LEADER _____

NOTE: (TONS), SYMBOL FOR CAPACITY OF BRIDGE FOR WHEELED VEHICLES IN TONS.

Figure 3. A form for reporting bridge information.

Section III

MOVEMENTS

8. Platoon Mission

During the movements of the battalion the pioneer platoon will frequently move at the rear of the support of the advance guard. Its mission during movements may be divided into two general classes:

a. To protect the battalion from delay by reducing obstacles or by constructing by-passes.

b. To impede or canalize the enemy by constructing obstacles such as road blocks or mine fields.

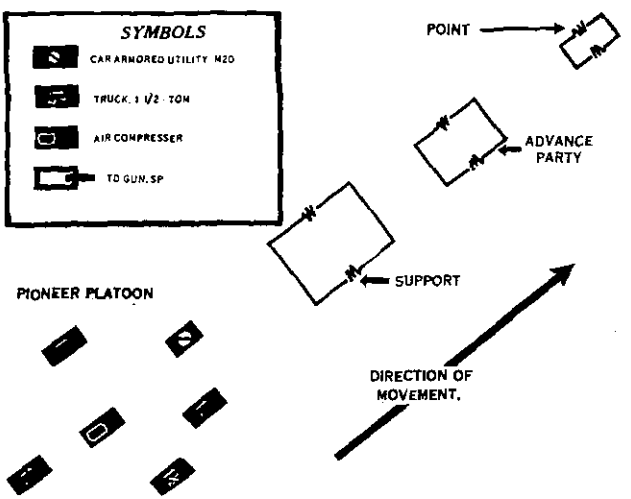


Figure 4.

9. Duties

The following check lists for duties performed prior to and during movements are given as guides. They should be amplified or modified as experience warrants.

a. PLATOON COMMANDER. (1) Alerts the platoon and issues warning order.

(2) Supervises the maintenance of vehicles and the checking and storage of weapons, ammunition, mines, tools, equipment, fuel supply, and rations. (These duties are continuous before, during, and after movements.)

(3) Checks radio net.

(4) Inspects the platoon and issues the final order. Insures that all know the situation, route, and destination; issues overlays or sketches of routes when time is available for their preparation.

(5) Checks intervehicular distance in both column and dispersed formations.

(6) Keeps oriented at all times by observation of terrain and map, and by noting odometer distances.

(7) Checks maintenance of prescribed speed.

(8) Checks observance of blackout instructions.

(9) Checks clearing of roads and proper use of cover and concealment at halts.

(10) At unscheduled halts, investigates the cause and reports it to the company or advance guard commander.

(11) Sees that all vehicles move at resumption of march—especially at night.

(12) Maintains prescribed contact.

(13) Reports mine fields.

b. PLATOON SERGEANT. Assists the platoon commander as directed.

c. SECTION LEADER. (1) Alerts section.

(2) Sees that all members of the section are thoroughly familiar with their specific assignments.

(3) Passes on to the members of the section all instructions from the platoon commander.

(4) Relays all prearranged signals.

(5) Checks weapons, explosives, mines, and equipment for completeness and stowage; checks machine guns for adjustment, serviceability, and ammunition.

(6) Checks vehicles for maintenance, fuel, equipment, and rations.

(7) Checks radios.

(8) Maintains control over section during movement.

(9) Maintains blackout discipline.

(10) Provides security on march and at halts as directed by the platoon commander.

(11) Sees that vehicles are properly dispersed and camouflaged at halts.

(12) Sees that one man in each vehicle is awake during halts at night.

(13) Maintains contact with adjacent section when prescribed.

(14) Rotates duties of personnel to provide sufficient rest for all.

d. ASSISTANT SECTION LEADER. Assists the section leader as directed.

e. AIR COMPRESSOR OPERATOR. (1) Checks vehicle for maintenance, fuel, and equipment.

(2) Checks air compressor tools for completeness, serviceability, and stowage.

f. RADIO OPERATOR. (1) Sees that radio is property netted and in operating condition.

(2) Operates and maintains radio.

(3) Assists in other duties as prescribed by the platoon commander.

g. DRIVER. (1) Operates vehicle and performs first echelon maintenance.

(2) Utilizes maximum cover and concealment in movement.

(3) Keeps vehicle in proper gear so maximum acceleration can be obtained when necessary.

(4) Remains with vehicle when halted, and dismounts only when directed.

(5) Mans the vehicular weapon when alone with vehicle during halts.

(6) Assists in other duties as prescribed.

10. Formations

Normally the platoon will move in a column formation with the air compressor in the middle of the platoon column. During movements across country, the formations used are adapted to the ground and will vary according to whether other troops are in the area and to the proximity of the enemy. Two standard formations used by the platoon are the block and the diamond. These formations are designed for security and control. The air compressor will take a position in the interior of the formation. The platoon may also use other formations, such as the line of sections and echeloned sections. Units that have need for

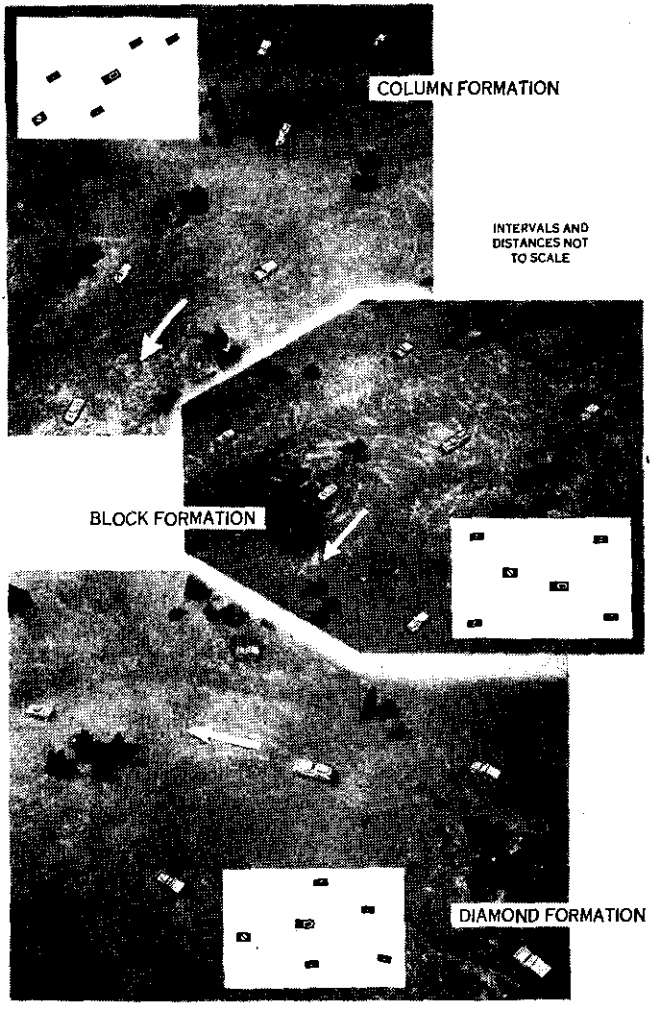


Figure 5. Platoon formations.

other formations should not hesitate to design them. Formations should be practiced until the platoon is perfect in their execution.

11. Security during Movement

a. MARCH SECURITY. While on the march the platoon commander provides for the security of his unit by the dispersal of vehicles, observation, the use of covered and concealed routes, avoidance of dust, detouring defiles where possible, camouflage discipline, blackout discipline, maintenance of radio silence, and the elimination of all unnecessary noise and traffic.

b. SECURITY AGAINST AIR ATTACKS. Security against air attacks on the march is gained by dispersion and alertness. When road space is available and control can be effectively maintained, intervehicular distance of about 175 yards is desirable. Movement cannot cease every time enemy planes appear, because such halting would enable a few enemy planes to keep a unit from performing its mission on time. For this reason, instructions as to whether to halt or keep moving in the event of air attack will be issued prior to the beginning of the march. The platoon takes immediate measures for protection against low-flying aircraft by using its own weapons which are suitable for *fire against aircraft.* Carbines, submachine guns, and pistols are not considered suitable weapons. All men must be prepared constantly for immediate action, but will fire only upon the order of an officer or responsible noncommissioned officer. *No aircraft will be fired upon unless it has been recognized clearly as hos-*

tile or is positively identified as hostile, or attacks with bombs or gun fire.

(1) When troops halt during an air attack, vehicles leave the road, when terrain and time permit, and halt under available concealment. Troops not manning antiaircraft weapons dismount and disperse; personnel fire all effective weapons at the attacking aircraft.

(2) When movement continues during an air attack, vehicles maintain distances on the road, or,

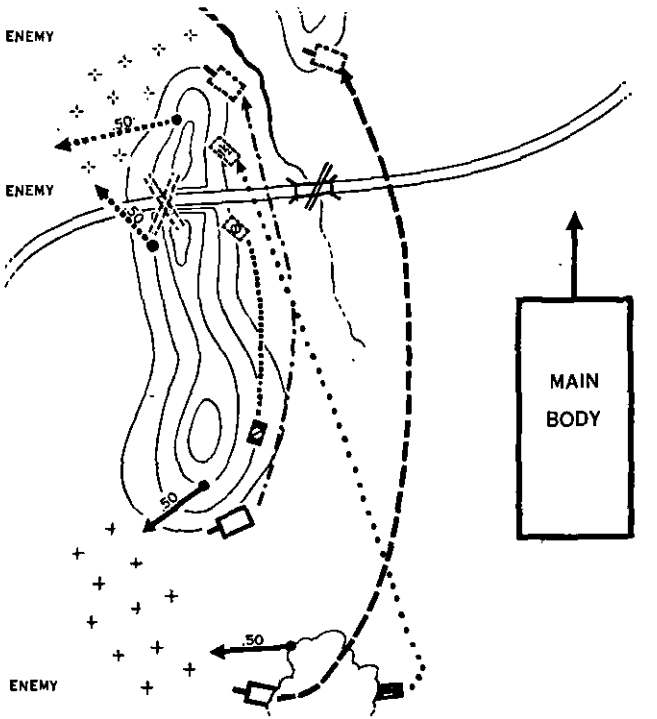


Figure 6. The pioneer section as part of a flank guard.

if the terrain permits, disperse laterally while continuing the forward movement. The fire of all effective weapons is brought against the attacking planes.

12. Flank Guard

The platoon or section may be attached to a flank guard. In such a case it may construct road blocks and lay hasty mine fields (with permission of higher authority) to assist in preventing the enemy from striking the flank of the moving column. The location of such obstacles is governed by the most likely approaches of the enemy. The platoon will remove the mines after the column has passed. Mine fields and road blocks will usually be covered by fire, and the platoon may be called on to help provide this fire.

13. Halts

a. Unscheduled halts may be the result of unexpected obstacles in the route. In such cases the pioneer platoon may be sent forward to reduce these obstacles. Speed in the execution of these tasks must be attained so the least possible delay in the movement of the column will result.

b. During normally scheduled halts the platoon commander ascertains that proper security measures, such as the dispersion and concealment of vehicles and personnel, are taken. He then checks the condition of vehicles and sees that proper maintenance is being executed. Normally, all personnel will be busy during halts. Resting is usually done only in bivouacs.

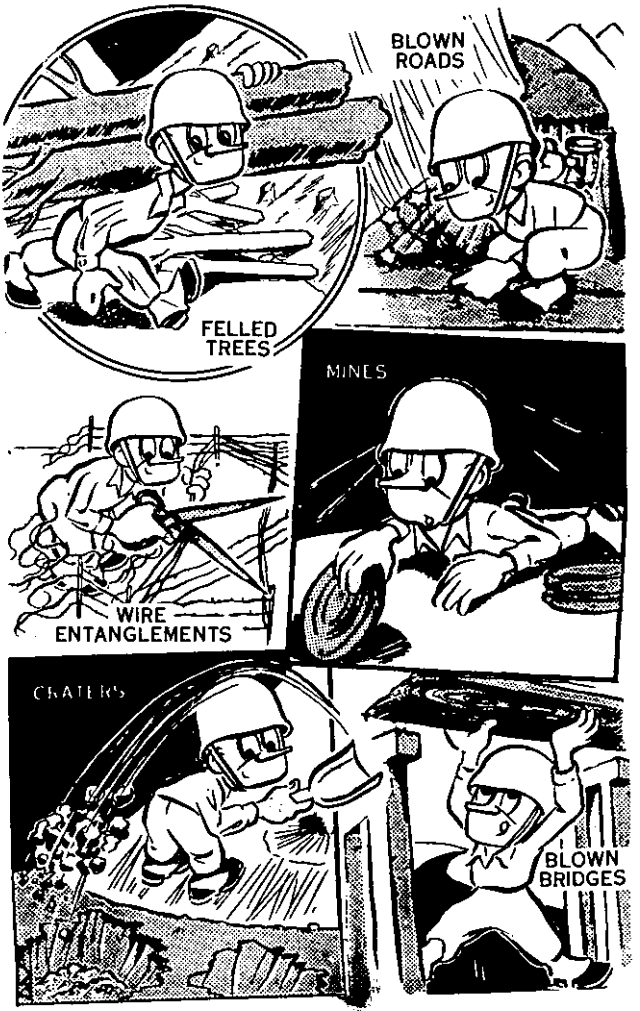


Figure 7. Reduction of obstacles.

14. Rail and Water Movements

Personnel from the platoon will be trained to assist the other units of the battalion in the loading, blocking, and securing of vehicles for movement by rail or water. The special pioneer equipment may be used to cut blocks and for whatever other purposes are found necessary. The platoon commander, assisted by some of his noncommissioned officers, may be detailed to inspect the work performed by the loading crews of the various companies.

Section IV

BIVOUACS

15. General

a. ENTERING BIVOUACS. When the situation permits, at least part, and preferably all of the pioneer platoon will precede the main body of the battalion to the selected bivouac area, accompanying the advance reconnaissance element or the quartering party. This gives time to make necessary improvements before the arrival of the main body. During movement into bivouac the essential requirement is speed in clearing the road and in finding cover and concealment. The platoon commander or a selected noncommissioned officer should precede the platoon into the area and be prepared to point out the section areas to the section leaders. After the road has been cleared and all the vehicles of the main body are under cover, the original platoon positions may be improved.

b. PLATOON PLAN. A platoon plan facilitates the occupation of a bivouac area. Under ordinary circumstances the platoon will occupy an interior position; all vehicles halt faced toward the route of egress. In rare instances, when the platoon occupies a portion of the battalion perimeter, the machine guns are dismounted and placed on the perimeter; vehicles again face the route of egress. The air compressor will be kept well toward the rear where it will receive the most protection.

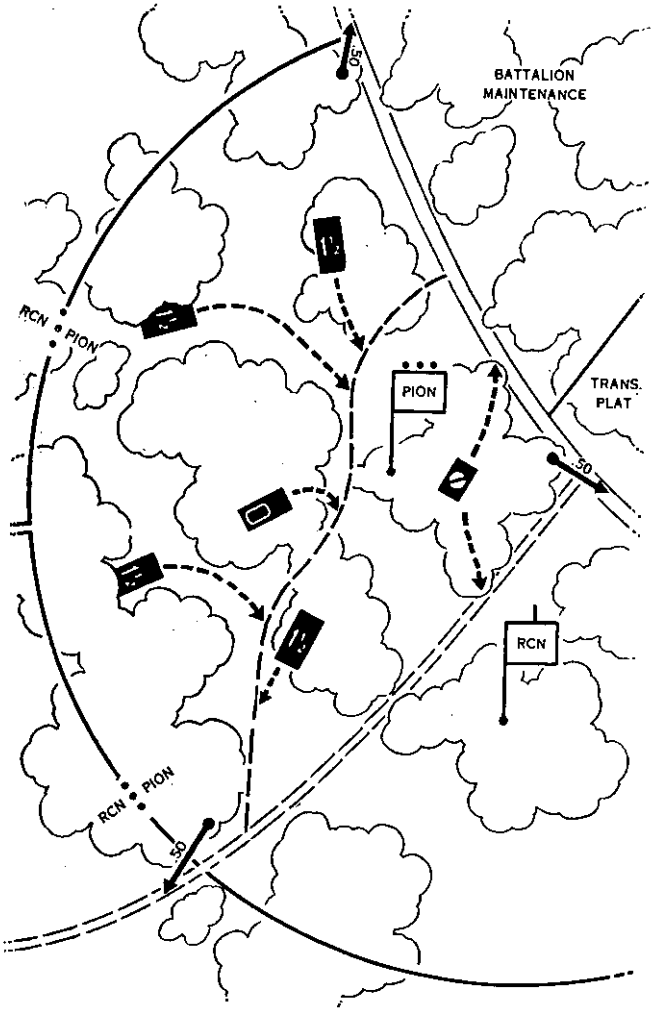


Figure 8. Disposition of platoon in bivouac.

16. Prior to Occupation by Main Body

a. GENERAL. There usually will be many tasks for the pioneer platoon to accomplish before the main body arrives at the bivouac area. Frequently the routes of ingress and egress to the bivouac will need improving, especially when the routes are muddy because of heavy rain or thaw. Typical improvements include filling ditches, holes, and cuts; cutting down humps or high ground; removing large rocks from the roads; and providing crossings over small streams. Any unexploded shells or bombs will be disposed of or marked (sec. XV). These improvements should be extensive enough to facilitate the passage of the heavy vehicles of the battalion.

b. IMPROVEMENT OF TRAILS. The trails and roads within the bivouac area may need improvement. To avoid excessive tracks within the bivouac, it is desirable to mark routes with white tape.

c. MINES. In situations where the bivouac area is in territory once held by the enemy, as will usually be the case, the area may have been mined or planted with booby traps. The pioneer platoon will locate and remove these mines and booby traps to make the area safe for the battalion (sec. XIV). If the area is mined extensively the pioneer platoon will need assistance in this work. When the bivouac area is found to be heavily mined, an alternate area should be selected and used if the situation permits.

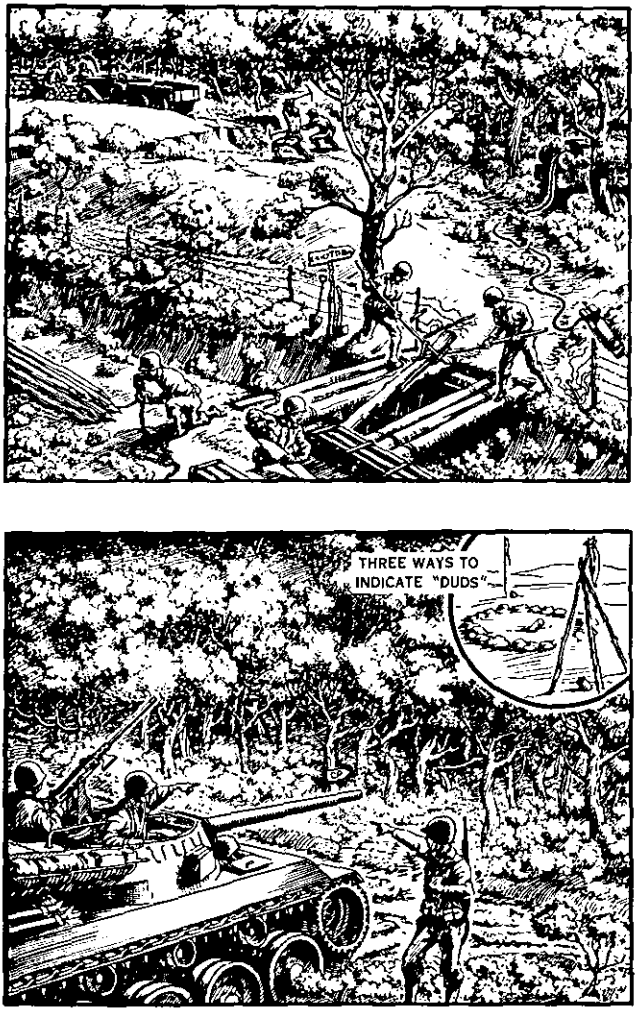


Figure 9. Improvement of bivouac routes.

17. During Occupation

a. GENERAL. During the actual occupation of the bivouac one of the principal duties of the platoon will be to assist the CP group and companies of the battalion in camouflaging and digging in. Where the ground is hard, demolitions may be used for emplacements and other protective measures. The platoon is equipped to do this work, but is limited by the amount of explosives carried.

b. PROTECTION FOR AREA. To provide protection for the bivouac area, the platoon can be utilized to prepare obstacles along the main avenues of approach. Road blocks, mined areas, or other prepared obstacles may be used. Permission from higher headquarters will be obtained before mines are laid or road blocks constructed. Mine fields laid will be marked and reported. The improvement of natural barriers usually is more effective and involves less work than the construction of new obstacles.

c. IMPROVEMENT OF LIVING FACILITIES. When the battalion is in a rest area, or when it appears that it may remain in a bivouac area for some time, the equipment of the pioneer platoon may be used to improve living facilities. Typical uses are—

(1) Constructing improvised showers.

(2) Improving cooking and serving facilities.

(3) Constructing shelter for the maintenance platoon.

(4) Providing dug-in storage for gas and oil cans.

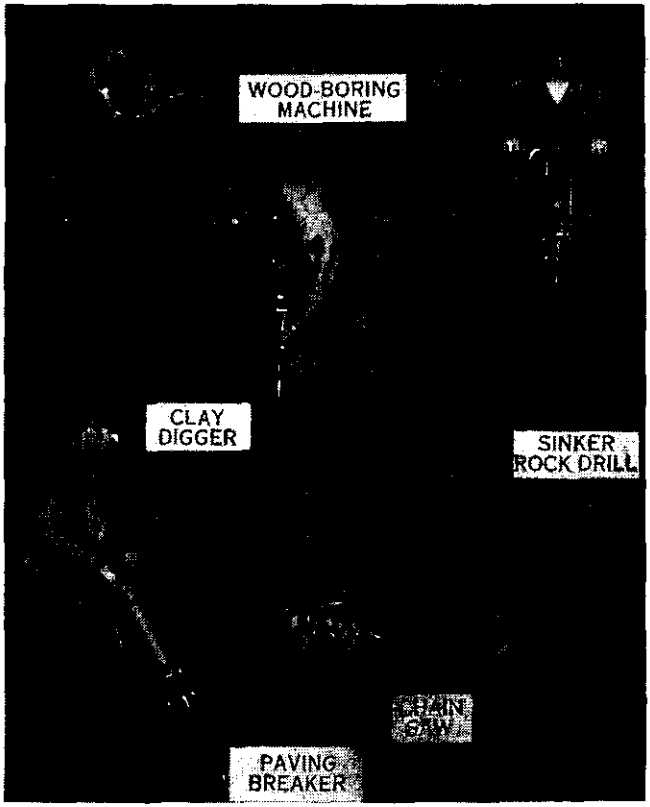


Figure 10. Power tools.

18. Security and Safety in Bivouac

a. SECURITY. The platoon security measures—outposts, dispersion, concealment, camouflage, blackout discipline and noise discipline—should be automatic. (For bivouac security in general see FM 18–5.) If the platoon bivouacs alone it

establishes outposts for all-round security. In those rare instances when the platoon occupies a portion of the perimeter of a bivouac of a higher unit, it will be assigned a security sector and will establish outposts. The mission of the outposts is to warn of surprise attack, to stop any attack by enemy troops, and to prevent infiltration into the area. Outposts maintain liaison, whenever possible, with more advanced observation and listening posts established by other units and coordinate their fields of fire with those of adjacent units. An adequate warning system is established.

b. BLACKOUT PRECAUTIONS Camouflage and noise discipline and the enforcement of blackout instructions are essential. Some common-sense blackout safety precautions are—

(1) Individual vehicles moving within the bivouac in blackout are preceded by a dismounted guide.

(2) Sleeping personnel are checked to see that none are near an engine exhaust or in front of or under a vehicle.

(3) When the platoon moves from bivouac in blackout, men are carefully checked to see that none are left behind.

19. Routine Duties in Bivouac

a. GENERAL. Besides the specific missions assigned to the platoon, there are certain general duties which will be performed after the bivouac has been occupied and organized for defense and security. Primary attention should be given to

the combat readiness of the vehicles, to the fighting and working equipment, and to the comfort and security of the men. Men take care of their vehicles and equipment before they take care of themselves. The platoon leader and noncommissoned officers see that vehicles, equipment, and men are taken care of before they make themselves comfortable. A check list for the platoon in bivouac is given below. It should be modified and amplified as experience warrants.

b. SECURITY.

Are the vehicles dispersed and camouflaged?

Are the machine guns sighted for mutual support and manned?

Is the air compressor placed in the best protected location?

Have blackout instructions been issued?

Have prone shelters or fox holes been dug?

Are sentries posted?

Is there relief for men on outposts?

Are antitank warning system signals understood?

Do the men know the challenge, password, and reply?

Are provisions made for proper action in case of air attack?

c. COMBAT READINESS.

Are the friendly and enemy situations known by all?

Is first echelon maintenance being performed?

Have all vehicles been refueled?

Is the air compressor in good operating condition?

Have the tools been checked and found ready for use?

Have the weapons been cleaned and checked for operations?

Do all vehicles and personnel have basic ammunition loads?

Have all radios been checked?

Are reserve rations on hand?

Is the platoon ready to move on a moment's notice?

d. CONTACT.

Has contact been established with adjacent units?

Has a messenger been sent to the company CP?

Has the company commander been informed of the disposition of the platoon?

Do members of the platoon know the location of the platoon CP? The company CP? The battalion CP? The battalion aid station?

Do the members of the platoon know the location and general disposition of the other platoons of the company? Do the key personnel of the platoon know the location of the men in bivouac?

e. LIVING IN AND LEAVING THE BIVOUAC.

Do the vehicles have firm standing?

Have latrine facilities been provided?

Have the men the best available shelter?

Is water available?

Have routes of egress been reconnoitered and suitably marked for night movement?

Is good camouflage discipline maintained?

20. Air attack

a. IN BIVOUAC. In the bivouac area all personnel of the pioneer platoon will dig prone shelters or fox holes. When hostile planes are sighted, fire will be withheld until it is determined that they have located tank destroyer units. Careless firing frequently discloses positions that would otherwise be unobserved. Enemy planes may attempt to draw fire for that purpose. If the planes have located tank destroyer units, fire power of all effective weapons will be used (par. 11*b*).

b. MOVING FROM BIVOUAC. Units are particularly vulnerable to air attack when moving out of bivouac. To avoid any possible congestion the platoon commander coordinates the egress of his unit with other troops in the area. All vehicles must be dispersed as they move out, not closed in with the idea of taking distance on the march.

21. Defense against Bivouac Raids

a. PLATOON PLAN. Each platoon should develop and practive a plan to execute in the event of a surprise raid, especially at night. Regardless of how far back a bivouac is, a sudden raid by infiltrating or airborne troops is always a possibility, and there may be no friendly troops between the tank destroyers and the enemy. In making defense plans the platoon area should be considered as a defense area and the weapons and

individual arms of the platoon employed to organize it.

b. ACTION DURING RAIDS. (1) Adequate defensive action during a night raid requires thorough training and rigid discipline. Each unit should adopt a standing operating procedure for defense at night. One method is to prescribe two alert signals, as follows:

(*a*) First signal is sounded when an enemy attack or infiltration appears imminent. All personnel occupy prepared positions with 50 percent on alert and others resting.

(*b*) Second signal is sounded when an enemy attack or infiltration is made. All personnel are alerted and remain in prepared positions. All movement within the area is assumed to be hostile and subject to immediate attack.

(2) The primary weapons for defense against close-in night attacks are antitank and antipersonnel mines, flares, grenades, bayonets and knives. The firing of weapons is rigidly controlled as their flash discloses the location of the firer. There is no withdrawal from a position during a night attack. All men must understand that they are "frozen" to their positions regardless of what happens.

Section V

POSITION IN READINESS

22. General

A position in readiness is an area which an organization occupies while the battle situation is developing. There will, in all probability, be several possible combat areas in which the action might take place. During the period of waiting for developments the pioneer platoon is prepared to move rapidly to execute any missions assigned.

23. Reconnaissance of Combat Area

While the position in readiness is occupied, pissible combat areas are reconnoitered. Usually the pioneer platoon commander and the two section sergeants go forward, one with each gun company commander, to estimate the extent of work required in missions which they may be called upon to execute within the different areas.

24. Occupation and Duties

Dispositions of troops and vehicles in a position in readiness are similar to those in bivouac (sec. IV). While the battalion occupies the position in readiness the pioneer platoon executes the missions assigned after the reconnaissance of the combat area. Principal missions at this time are to see that routes to the selected combat areas are free from obstacles, both natural and man-made (FM 5–30). When time permits, the platoon may assist in improving gun positions. The missions of the platoon may be numerous: therefore the battalion plan of action determines the priority of such tasks.

Section VI

COMBAT AREA

25. Obstacles

a. REMOVAL OF OBSTACLES. It is a function of the pioneer platoon to remove or assist in removing obstacles, both natural and artificial, including mine fields and booby traps (FM 5–30).

b. CONSTRUCTION OF OBSTACLES. When time permits the deliberate occupation of positions, all possible means of forcing the enemy to fight on ground chosen by the tank destroyers should be used. The pioneer platoon will often be directed to move forward to execute demolitions, lay mines, build road blocks, and construct other obstacles with which to canalize the movement of the enemy (FM 5–30). In selecting gun positions there may be approaches which cannot be covered by fire from the destroyers. Obstacles will be constructed to deny the enemy the use of such approaches. The pioneer platoon may be required to assist the security sections of the gun platoons in covering these obstacles by fire.

26. Preparation of Gun Positions

Frequently the pioneer platoon will be employed to assist gun crews in preparing gun positions. The equipment and training of the personnel adapt them to jobs such as assisting in digging gun positions, preparing camouflage, clearing fields of fire, and improving routes into and out of position. The platoon also may be employed

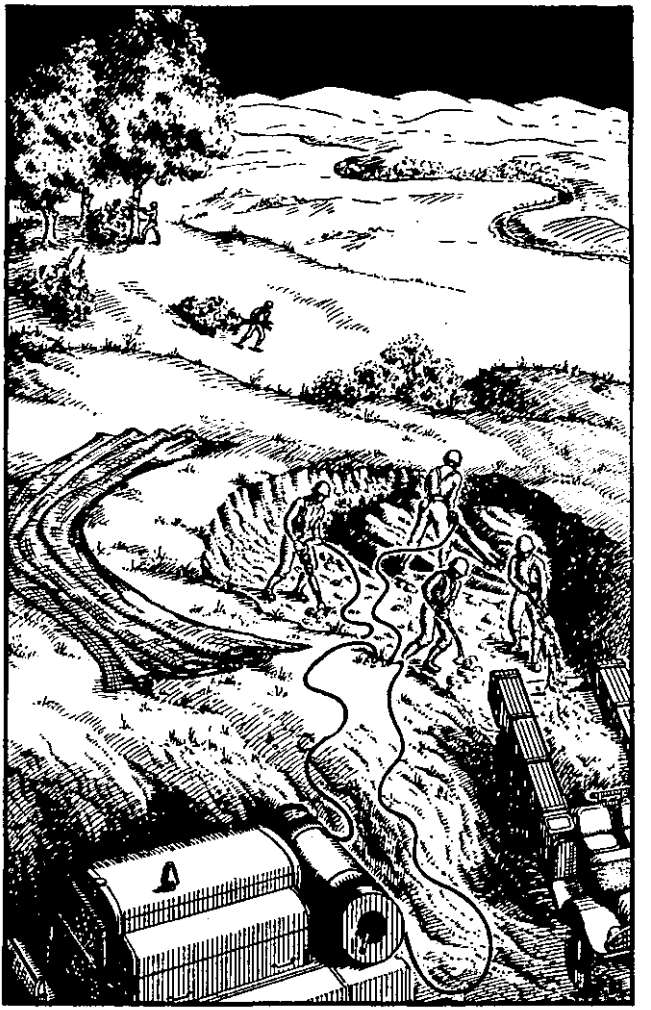


Figure 11. Preparation of a gun emplacement.

to assist in the preparation of alternate and dummy gun positions. To add realism to dummy positions the platoon may equip them with explosive charges called fougasses (par. 53).

27. Fire Fight

During the fire fight the pioneer platoon reorganizes, if necessary, and assists in the defense of the command post. It will be prepared at all times to move forward and perform new missions.

28. Retrograde Movements

During a retrograde movement the pioneer platoon is generally assigned to the rear guard to assist in delaying the enemy. The platoon prepares road blocks, increases the effectiveness of natural obstacles, lays hasty mine fields, and prepares bridges and defiles for demolition as directed by the rear guard commander. In turn, the rear guard covers the obstacles with fire while the pioneer platoon moves on to the next task in the movement. Authority from the rear guard commander, who in turn will have obtained permission from division or higher commander, must be obtained before laying mine fields, installing booby traps, or executing demolitions.

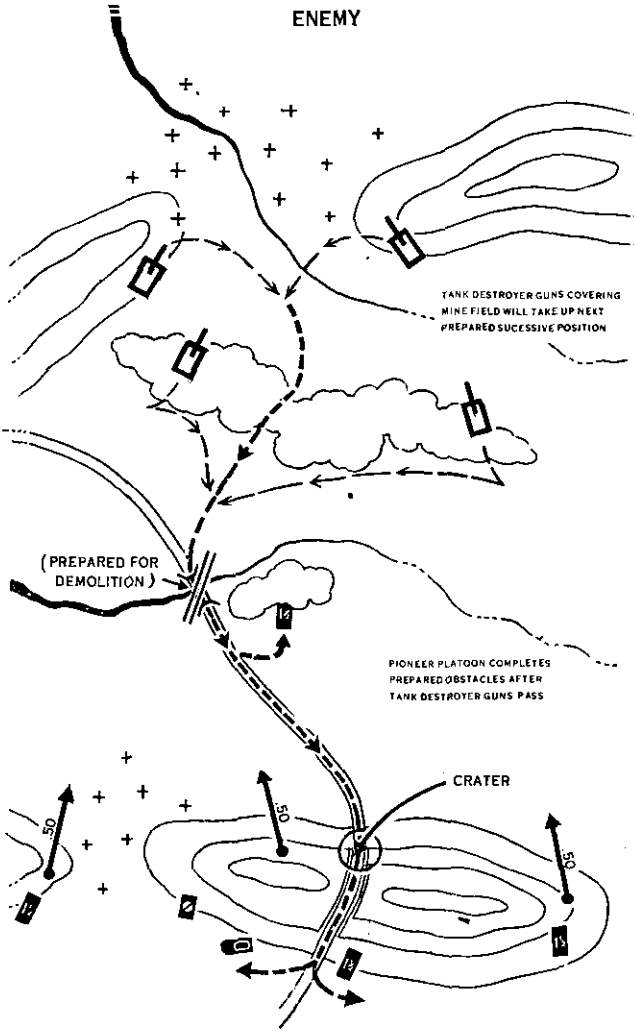


Figure 12. Action with rear guard during retrograde movements.

Section VII

TECHNICAL TRAINING

29. Mission

From the previous discussion of the two general missions it will be noted that the tasks of the pioneer platoon are similar to those of a platoon of combat engineers. The technical training of the platoon must therefore be similar to that of engineers. The personnel should be trained thoroughly in the technique of constructing and removing obstacles and in at least the elementary engineering tasks commonly assigned to the platoon.

30. References

a. In addition to the techniques described in this manual, the personnel of the pioneer platoon should be trained in all the techniques given in FM 5–10, Construction and Routes of Communications, FM 5–30, Obstacle Technique, FM 5–31, Land Mines and Booby Traps, and in the following subjects in FM 21–105, Engineer Soldiers' Handbook:

Engineer tools and common engineer tasks.
Elementary rigging.
Camouflage.
Explosives and demolitions.
Bridges.
Engineer reconnaissance.
Combat weapons.

b. In using FM 5–10, FM 5–30, FM 5–31, FM 21–105, and other manuals referred to in this text, the subject material must be adapted to the organization and equipment of the platoon.

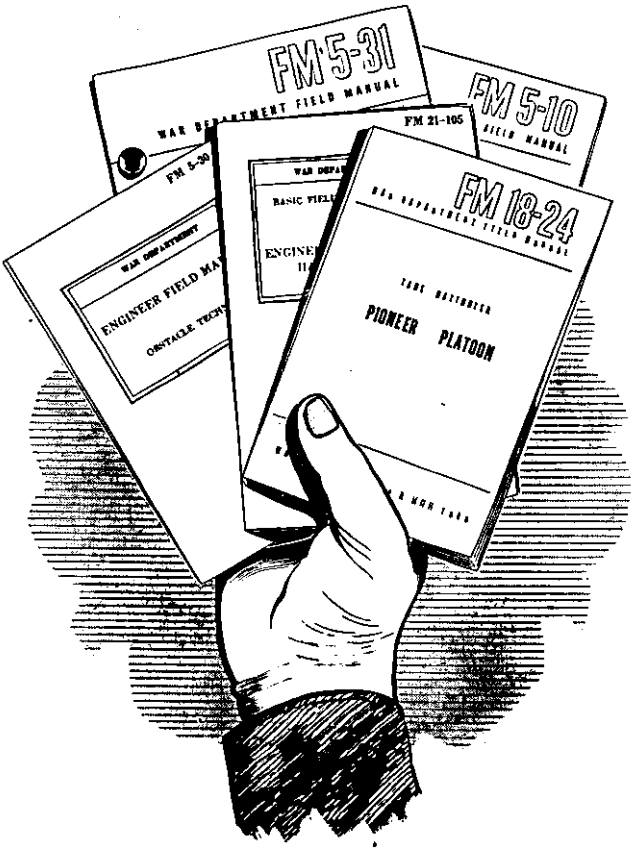


Figure 13. Technical references for the pioneer platoon.

Section VIII

SAFE STRENGTH OF EQUIPMENT

31. General

As members of the pioneer platoon will frequently be working with ropes, chains, winches, and like equipment, they must know the safe working strength of this equipment. Should the equipment break while being used, personnel may be injured and the mission may not be performed. To satisfactorily complete a mission with the least danger to personnel, *the load should always be kept within the safe working strength of the equipment being used.*

32. Rope, Wire, and Chain (FM 5–10).

The following simple rules are applied to determine the safe working load of rope, wire rope, and chain:

a. ROPE. Working strength (in tons) equals the diameter (in inches) squared ($T = D^2$).

Example: The safe working strength of a ½ inch rope is ¼ ton—

T (tons) $= D^2$ (diameter in inches squared)

$T = ½ \times ½ = ¼$ ton.

b. WIRE ROPE. Working strength (in tons) equals eight times the diameter (in inches) squared ($T = 8D^2$).

Example: The safe working strength of a ½ inch wire rope is 2 tons—

T (tons) $= 8D^2$ (diameter in inches squared)

$T = 8 \times ½ \times ½ = 2$ tons.

c. CHAIN. Working strength (in tons) equals eight times the diameter (in inches) squared ($T = 8D^2$). (Measure the thinnest portion of a link of chain to find the diameter.)

Example: The safe working strength of a ½ inch chain is 2 tons—

T (tons) $= 8D^2$ (8 $\times$ diameter in inches squared)

$T = 8 \times ½ \times ½ = 2$ tons.

33. Winches

a. CAPACITY. The table below shows the capacities of winches used by the battalion. These capacities must not be exceeded. When there is danger of exceeding the capacity of the winch, the load can be lessened by using blocks (see FM 21–105).

Weight of vehicle	*Winch capacity, lbs.*
½ ton and ¾ ton	5,000
1½ ton and 2½ tons	10,000
4 tons and larger	15,000

b. SHEAR PINS. To protect against overload, the propeller shaft universal joint is fastened to the worm shaft of the winch by a shear pin which will break if the winch is overloaded. The shear pin is installed as a safety measure; only the specified pin should be used for replacement. If the pin will not stand the strain, reduce the load on the winch.

c. OPERATION. The winch has two forward speeds and one reverse speed. The lower speed should be used for heavy loads. The winch must be operated with a constant tension on the line, as the winch will not withstand a sudden snap or strain.

Section IX

ROAD EXPEDIENTS

34. General

The pioneer platoon ordinarily is not called upon to make permanent road repairs, but is expected to employ expedient methods for hasty road repairs and construction. The type of road built depends on the time available and the usable materials near the road site. (FM 5–10 presents additional road expedients.)

35. Corduroy Roads

a. USAGE. The corduroy road is one of the most reliable and widely used expedient roads. It may be constructed easily and rapidly when timber is conveniently available. The platoon may construct corduroy roads to improve soft approaches to fords and bridges and to negotiate mud holes and short stretches of swampy ground.

b. CONSTRUCTION. The corduroy road is built by laying logs, split or round, crosswise to the axis of the road. The logs should have a mean diameter of 6 inches, be as nearly the same size as possible, and be laid by alternating tips and butts. If the logs are large, the spaces may be filled with smaller poles. These poles should be trimmed to fill the gaps closely. To make the road smoother for traveling, the entire structure may be covered with a layer of hay or same similar material which

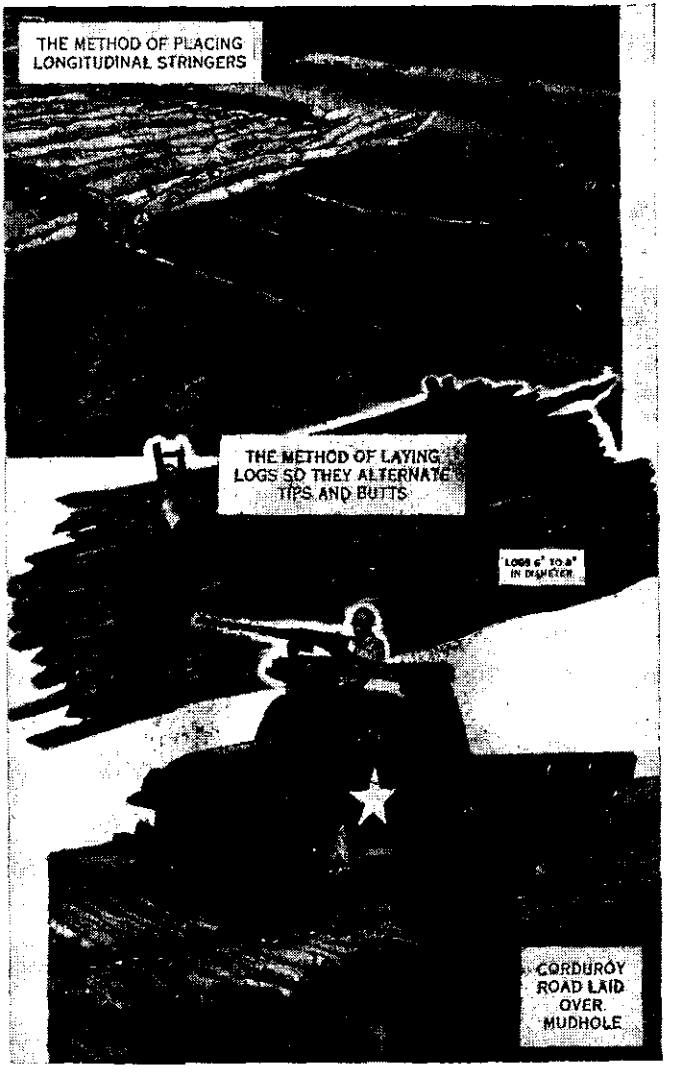


Figure 14. Corduroy roads.

is then covered with a layer of dirt. If the soil is reasonably solid, the logs need be only as wide as the width of the road; on marshy ground, the logs must be wider than the road.

c. CURBING. Logs should be used as curbing on corduroy roads. This log curbing is spiked, wired, and staked in place on the upper surface and outer edges of this type road. The curbing helps to bind the logs of the road together and to keep the road itself in place. Curbing is also useful in keeping in place any hay, dirt, etc., that is used to cover the roads. Whether the road is covered or not the curbing serves to prevent vehicles from slipping off the road.

36. Wire Mesh Roads

a. CONSTRUCTION. When deep, dry sand is to be crossed and no material for a corduroy road is available, a chicken-wire, hog-wire, or other heavy-wire mesh road may be constructed. Ordinary 3-foot rolls of wire may be used and several widths wired together with a one-foot overlap to construct the desired width of road. The entire mesh should then be solidly anchored. A single thickness may be sufficient for light vehicles; however, three thicknesses, with burlap or brush between layers, are required for cargo and other heavy vehicles. Such mesh roads may be covered with dirt.

b. MAINTENANCE. Constant maintenance is necessary to repair holes in wire and to keep the wire taut with the surface of the sand. Traffic

should never be allowed to cross a wire-mesh road at right angles. If such traffic is necessary, appropriate plank or other type of crossing should be made.

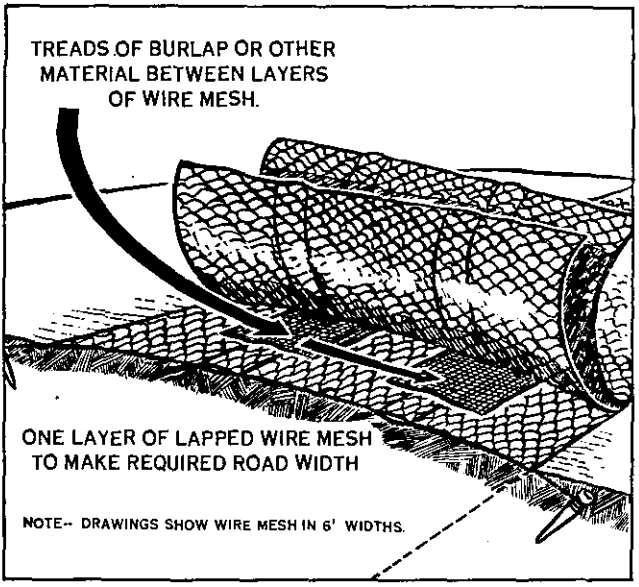
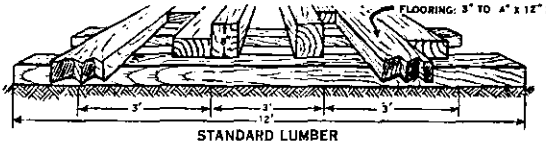


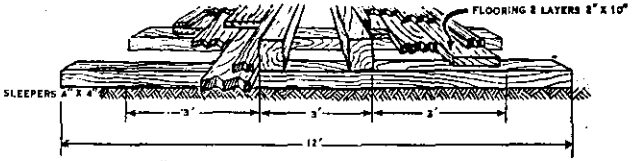
Figure 15. Wire-mesh roads.

37. Tread Roads

Short sections of this type of road may be constructed when time and materials are limited. It is otherwise less desirable than other types. Spacing of cross ties is generally 3 feet but may vary with subgrade conditions. Inside curbs are necessary to prevent vehicles of various width treads from driving off road.

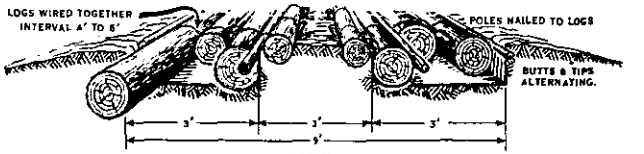


STANDARD LUMBER



CROSSTIES 6" X 6" X 12", APPROXIMATELT EVERY 3'-0" DEPENDING ON SOIL CONDITION

IMPROVISED LUMBER



CORDUROY

Figure 16. Types of tread roads.

Section X

STREAM CROSSING EXPEDIENTS

38. Fords

a. GENERAL. If a bridge is not available, fording a stream is ordinarily the quickest and easiest way to cross it. Even though there may be a bridge, a ford should be located in the event the bridge is rendered unserviceable by enemy action. If the selected ford site needs improvements, the pioneer platoon will be called on to do the work if the job is not too extensive.

b. FORDABILITY OF VEHICLES. The depth of water that normally can be forded by the vehicles of the battalion is shown in the table below:

Vehicle	*Normal fordability in inches*
Truck, ¼-ton	18
Truck, ¾-ton, weapons carrier and command	34
Truck, 1½-ton, 6 x 6, cargo, w/winch	34
Truck, 2½-ton, cargo, w/winch	36
Compressor, air, motorized	36
Truck, heavy wrecker, w/winch	40
Car, armored, light, M8	34
Car, armored, utility, M20	34
Vehicle, tank, recovery	36
Carrier, personnel, half-track M3	32
Carriage, motor, 76-mm gun	48
Carriage, motor, 3-inch gun	36

c. IMPROVING APPROACHES. To maintain traffic flow, the approach to and the exit from the ford, whenever possible, should be perpendicular to the stream for at least fifty yards. The approaches must be firm enough to support the vehicles of the battaion and have a slope gradual

Figure 17. Ford improvements.

enough for the vehicles to enter and exit easily. Soft approaches may be improved by the construction of corduroy roads or other road expedients. Steep approaches may be cut down either by hand labor or by the use of explosives.

d. IMPROVING STREAM BED. If the stream bed is not firm enough to support the vehicles, it may be improved by constructing a semi-floating corduroy road with the logs wired together and anchored at each end to keep the current from shifting the road. The stream bed may also be improved by placing sand bags or heavy-wire mesh to form a roadway. On a dry sand bar a chicken-wire or hog-wire road may be constructed.

39. Floating

When suitable fords cannot be found or where the water is too deep to be forded by the smaller vehicles, these vehicles may be floated across the stream. One method is by the use of tarpaulins of large vehicles to float the smaller vehicles. The tarpaulin from a 2½-ton truck is large enough to provide a float for a ¼-ton truck.

Figure 18. Floating a vehicle.

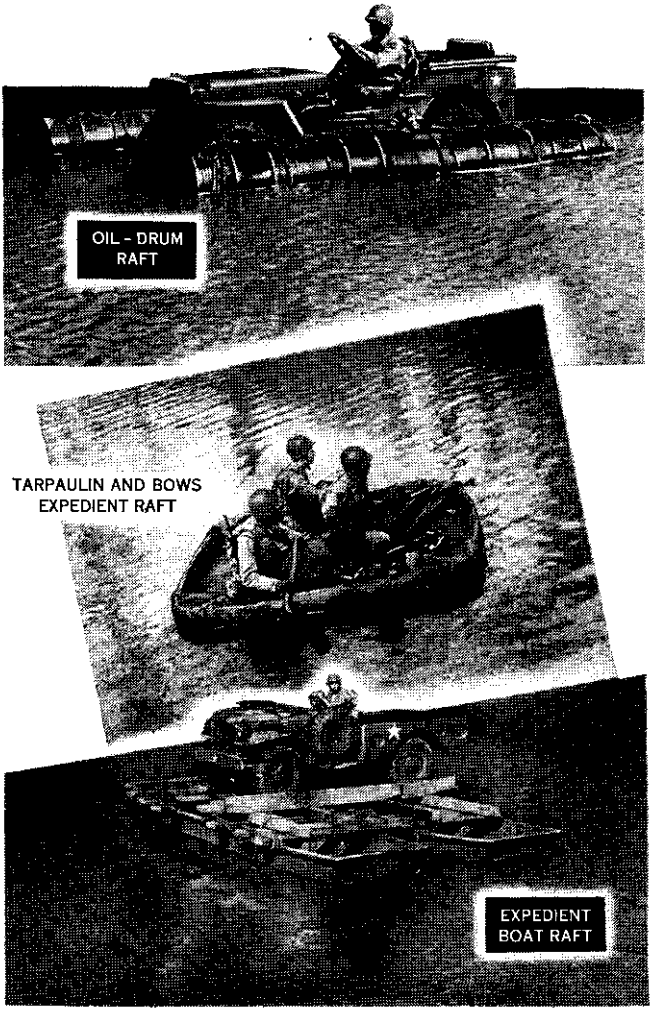


Figure 19. Types of rafts.

40. Rafts

The lighter vehicles may also be transported on rafts constructed from oil drums, logs, or boats. Rafts made from vehicle tarpaulins on a framework of saplings, boards, or truck bows can be used to transport men and light equipment.

41. Cable Ferry

When the banks are steep, the water too deep for fording, or the current too swift for floating, personnel and light equipment can be ferried by using the winch cable of a vehicle. Heavier equipment up to a ¼-ton truck can be ferried by using two 2½-ton truck winch cables (ch. 11, sec. IV, FM 5–10).

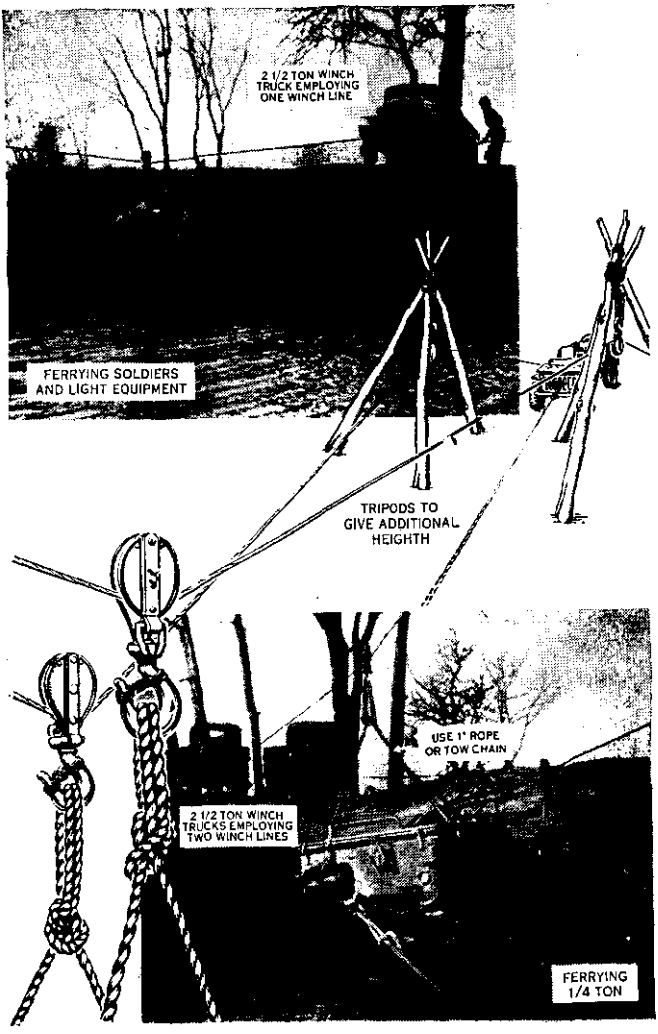


Figure 20. Cable ferry.

Section XI

BRIDGE STRENGTHENING

42. Nomenclature of Military Bridges

Bridges may be encountered which are not strong enough to support the vehicles of the battalion, but which may be strengthened sufficiently. Sometimes it may be necessary to erect entire small bridges. In order to estimate the capacity of a bridge and the work necessary, and to do the work efficiently, all personnel of the platoon must be thoroughly familiar with the nomenclature of the standard military bridge. The diagrams shown in figures 21 and 22 should be studied carefully. It should be noted that 10 feet between curbing is insufficient for some military vehicles. The maximum capacity of bridge type shown in figures 21 and 22 is 24 tons when span length is at its maximum of 15 feet.

43. Addition of Bents

a. GENERAL. Ordinarily, the best method of strengthening the span of a bridge is to insert additional supports in the center of the span. The standard trestle bent is the easiest and quickest support to build and will approximately double the strength of the span. Where the ground under the bridge is uneven, the posts may be cut to suit the terrain and a common cap may be used on top of the posts. If this is done a separate footing is usually required under each post.

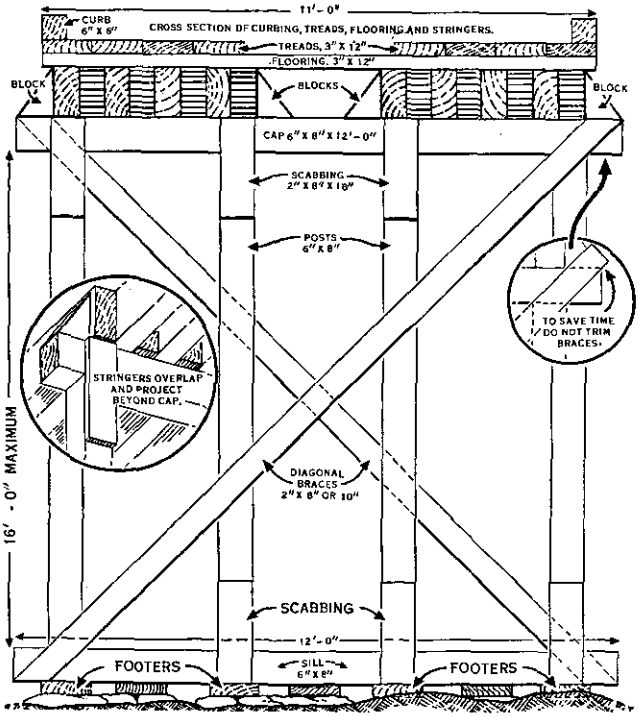


Figure 21. Cross section of bridge.

b. WEDGING ADDITIONAL BENTS. If the standard trestle bent is used for an additional support, wedges may be used to eliminate the excessive amount of time needed to construct a bent of the exact height necessary. The posts should be cut from 3 inches to 4 inches shorter than necessary and a double wedge driven between the cap and each stringer so the load will be transferred from the stringers to the bent. Constant mainte-

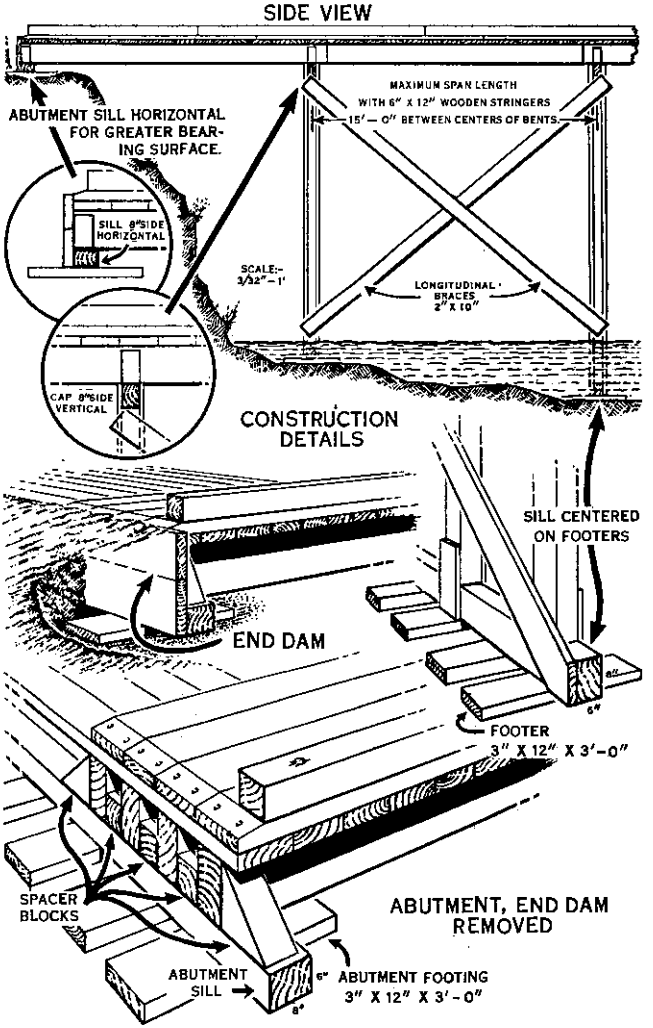


Figure 22. Side view and construction details.

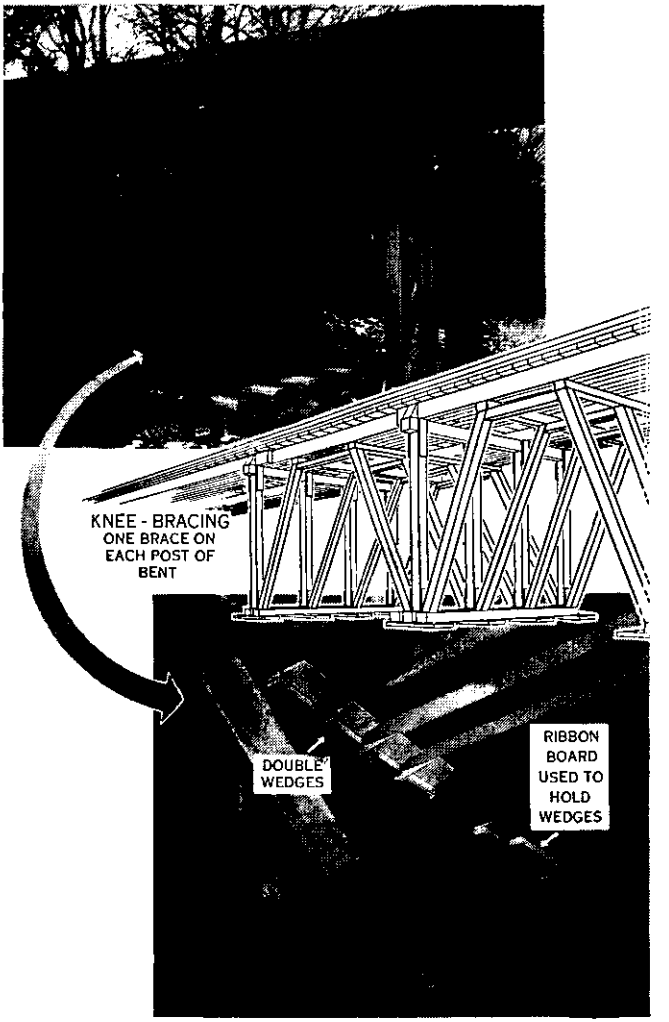


Figure 23. Addition and bracing of bents.

nance of these wedges will be required to keep them bearing against the cap and stringers. A ribbon board (figure 23) may be nailed across the stringers to keep the wedges in place.

c. KNEE BRACING. Knee bracing can be used to add rigidity to the bridge. There should be one brace on each post of the bent.

44. Construction of A-frame

a. In places where the water is too deep for bents, the **A**-frame may be used to strengthen a span. **A**-frames are more difficult to construct than standard bents; however, the following discussion presents a simple method of construction that can be used by the pioneer platoon.

b. The easiest way to lay out the length and angles of an **A**-frame is by the use of a steel square. To do this, the length of the span from post to post (L) must be known, and the height of the span from the sill to the stringer (H). Four inches are subtracted from the height (H), giving the dimensions (H–4 inch). The 4 inches thus subtracted, together with the 4 inches that will be cut from the apex of the assembled **A**-frame to provide a flat seat for the cap (figure 26), allows 8 inches for the 6-x-8-inch cap to be placed between the **A**-frame and the stringers.

c. As any two bents may be of different heights, it may be necessary to lay out each leg of the **A**-frame separately. The first step in laying out a leg is to place the steel square on the end of the timber which is to be the bottom of the leg, letting

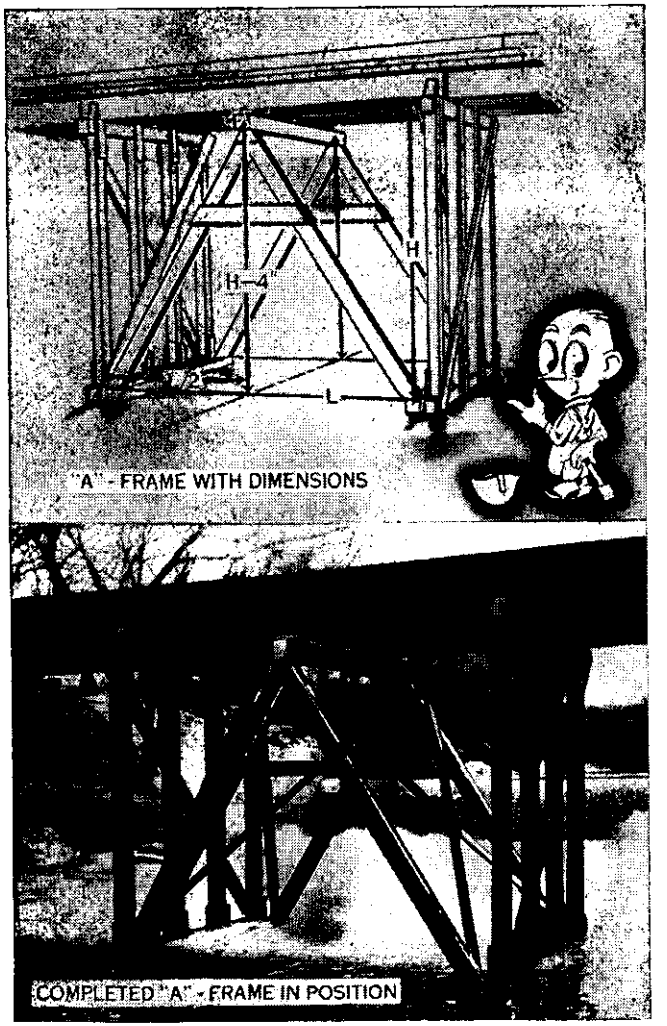


Figure 24. Completed A*-frame with known dimensions.*

one inch on the scale equal one foot on the timber. With $L/2$ on the right scale and H–4 inch on the left scale, the line AC is drawn and point B marked as shown in figure 25.

d. The distance AB is measured. Then, letting each inch on the scale equal one foot on the timber, the length AD is laid out so that AD in feet is equal to AB in inches. This will give the length of the A-frame leg as shown in figure 25.

e. To lay out the point of the A-frame leg, the steel square is placed on the opposite end of the timber so that the left scale touches point D at H–4 inch and $L/2$ still intersects line AD. The line DE is drawn as shown in figure 25.

f. The timber is cut along AC for the bottom of the A-frame leg, and along DE for the top of the leg. Four inches are cut from the point of the A-frame to allow room for an 8-inch cap to fit between the top of the A-frame and the stringers.

g. In finding the dimensions for the left A-frame leg, it should be noted that $L/2$ equals 7 feet on the bridge and 7 inches on the square, and H–4 inch equals 10 feet on the bridge and 10 inches on the square. By properly placing the square on the timber it is found that the distance from point A to point B is 12.2 inches; therefore, the distance between point A and point D is 12.2 feet. The same procedure is followed to lay out the right A-frame leg except that measurements must be taken to find the new value of H–4 inch since the right bent is shorter than the left bent.

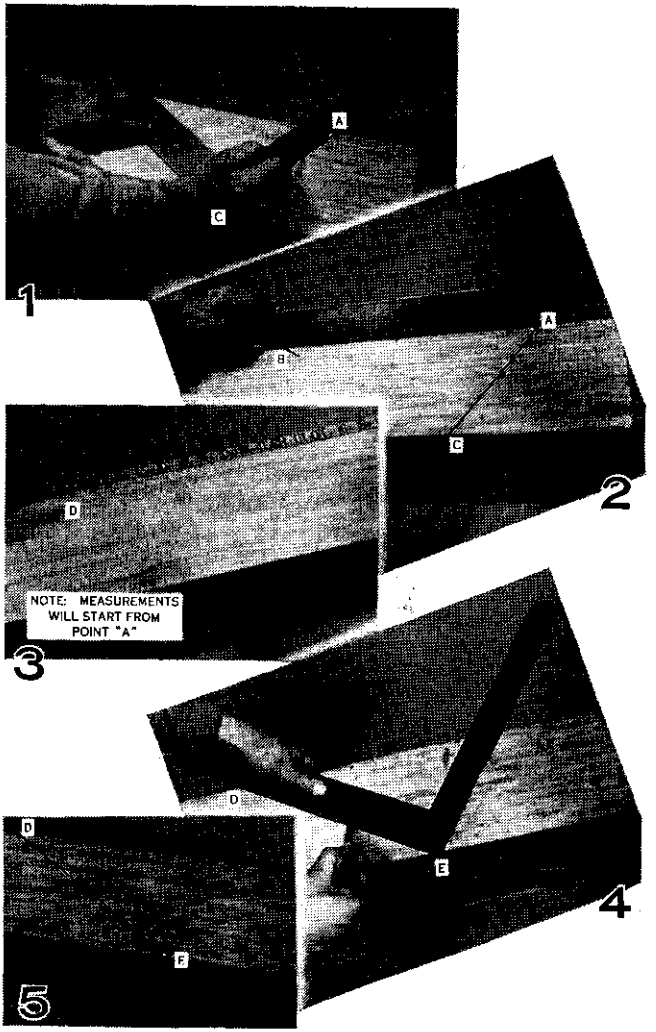


Figure 25. Laying out leg of **A***-frame.*

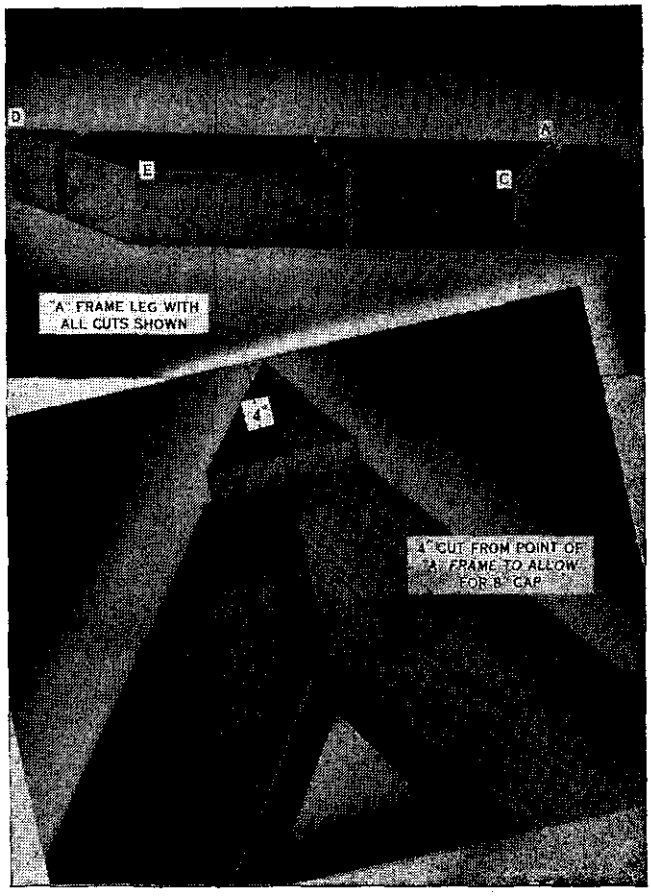


Figure 26. Cutting **A***-frame leg.*

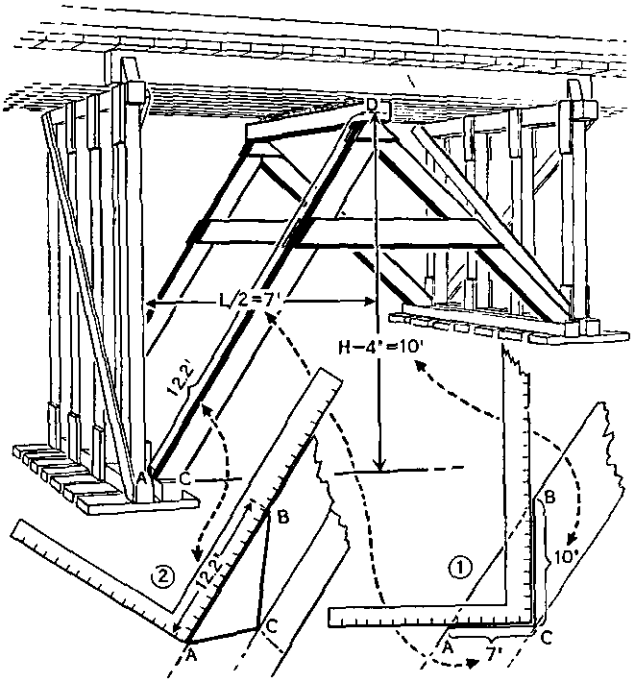


Figure 27. **A**-*frame with uneven legs.*

45. Addition of Stringers

Bridges may be strengthened by the use of additional stringers. These may be added either by jacking up the floor and inserting a stringer, or by hewing approximately one inch from the under side of a new stringer for a distance of two feet from the end, fitting the stringer into place paralleling the old stringer, and blocking it up with double wedges placed between the cap and the stringer after the latter is in position. If neces-

sary, all the flooring may be removed to expedite the placing of extra stringers.

46. Replacing Posts

It may be possible to repair broken posts by nailing scabs over the breaks. If a broken post cannot be repaired, another post is cut and slid into place beside the broken one. To cut and place a new post that exactly fits is a tedious job. The posts should, therefore, be cut slightly shorter than the required elength and tightened in place with wedges.

47. Other Strengthening Methods

The impact load of a bridge can be reduced and the capacity of the span increased by smoothing the flooring. Loose boards are nailed down and rough spots chipped off. All broken planks are replaced. The addition of a tread will distribute the load on the flooring more evenly and increase the bridge capacity. If the material is available and if the bents are in good condition, a new set of stringers and a new floor can be laid directly over the old floor.

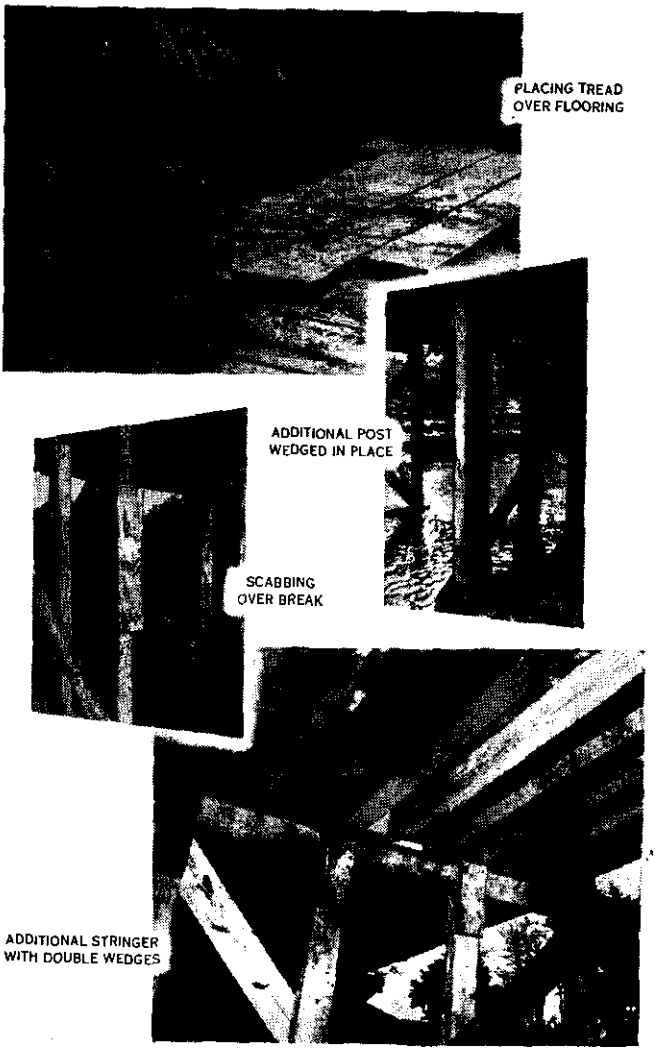


Figure 28. Other methods of strengthening bridges.

Section XII

DETERMINING CAPACITY OF BRIDGES

48. Weight of Vehicles

a. GENERAL. To be able to determine whether or not a bridge will support the vehicles of the battalion and the amount and kind of repairs needed to strengthen the bridge, members of the pioneer platoon must be thoroughly familiar with the weights and types of the various vehicles of the battalion.

b. NORMAL WEIGHTS. The following table gives the gross weights of the battalion vehicles with a normal load. A system of using the equivalent weight of vehicles for various span lengths of stringer-type bridges (FM 5–10) may be used to determine passability of vehicles across bridges having load capacity posted.

Vehicle	*Gross weight with normal load*
Truck, ½-ton	3,125
Truck, ¾-ton, weapons carrier or command	6,800
Truck, 1½-ton, 6 x 6, cargo, w/winch	10,225
Truck, 2½-ton, cargo, w/winch	15,000
Compressor, air, motorized	13,000
Truck, heavy wrecker, w/winch	37,000
Vehicle, tank, recovery	70,000
Car, armored, light, M8	16,000
Car, armored, utility, M20	15,500
Carriage, motor, 90-mm gun, M36	63,500

Carriage, motor, 76-mm gun	38,500
Carriage, motor, 3-inch gun	64,000
Carrier, personnel, half-track, M3	19,000
Trailer, ¼-ton	1,060
Trailer, 1-ton	3,300
Trailer, ammunition, M10	4,000
Gun, 3-inch, M5 and carriage, gun 3-inch, M1	5,100
Gun, 3-inch, M5 and carriage, gun 3-inch, M6	5,900

c. PASSAGE WITH CAUTION. It should be remembered that when the weight of a vehicle is near the capacity of the bridge, extreme caution must be used in crossing. Ordinarily a bridge will carry a 25 percent overload if the following precautions are taken: Vehicle must stay on center line of bridge. Speed not over 5 miles per hour. Distance between vehicles, at least 50 yards. No braking or gear shifting on bridge. While the 25 percent overload does not apply to floating bridges, passage with caution means the same as on fixed bridges except that speed must be reduced to 3 miles per hour.

49. Bridge Cards

a. GENERAL. A rapid means of determining the capacity of bridges and the amount of repairs needed is by the use of bridge cards. Each pioneer platoon leader and at least the members of the platoon who will be sent on the reconnaissance missions should have copies of the bridge cards that apply to the vehicles of the battalion. The use of these cards should be practiced so all members of the platoon can use them rapidly and

accurately. Structures must be examined for soundness of timber and steel deterioration and appropriate reductions in capacity made accordingly. For special cases involving towed loads see paragraph 50.

b. BRIDGES OF MORE THAN ONE LANE. (1) *General rule.* The bridge cards present a method of determining the capacity of a span of one lane only. To find the capacity of each lane of a two-lane span, count the stringers under each lane and solve for each lane separately. Thus, the span may be found to have a capacity of two 10-ton vehicles (one in each lane), but this does not mean it will carry one 20-ton vehicle.

(2) *Emergency passage.* In an emergency the capacity of a two-lane bridge may be exceeded by observing the following procedure—count the stringers in both lanes of the span and multiply this number by ¾; then, using this result as a total number of stringers in a span of a 1-lane bridge, find the capacity of the span. *When this method is used only one vehicle should be on any one span at one time, and it must be driven along the center line of the bridge.*

c. WHEELED VEHICLES AND HALF-TRACKS. Half-tracked vehicles can safely cross all bridges capable of carrying wheeled vehicles of the same weight. The following bridge cards may be used to determine the weight of wheeled vehicles or half-tracks which a one-lane bridge will support.

(1) *Rectangular wooden stringers with timber flooring.* The card below shows the safe *gross load* in tons for stringers one inch wide.

Span in Feet	Depth of Stringer in Inches									
	6	8	10	12	14	16	18	20	22	24
10	.19	.34	.55	.80	1.05	1.40	1.75	2.15	2.65	3.15
12	.15	.28	.44	.65	.90	1.15	1.45	1.80	2.15	2.60
14	.13	.24	.37	.55	.75	.95	1.25	1.55	1.85	2.20
15	.12	.22	.35	.50	.70	.90	1.15	1.40	1.70	2.05
16	.11	.20	.32	.47	.65	.85	1.05	1.30	1.60	1.90
18	.10	.18	.28	.41	.55	.75	.95	1.15	1.40	1.70
20		.16	.25	.36	.50	.65	.85	1.05	1.25	1.50
24		.11	.19	.27	.38	.50	.65	.80	.95	1.15
28		.09	.15	.22	.32	.42	.55	.65	.80	.95

Figure 29. Wheeled vehicle bridge card (wooden stringers).

Example: To determine the capacity of a 1-lane bridge which has six 8-x-x10-inch wooden stringers over a span of 18 feet.

Solution: The column for the depth of stringers of 10 inches is intersected by the line for a span of 18 feet. The figure .28 appears in the block at the junction of the two columns. This (.28) is the number of tons one 1-inch stringer would support. The actual stringer width of the bridge is 6 (number of stringers) × 8 inches (width of each stringer) or 48 inches. The safe capacity of the bridge is therefore .28 (capacity for a width of 1-inch) × 48 (total width) equals 13.4 or 13 tons.

Round stringers. For stringers of round timber, the diameter of the timber at the center of the

span is used as the depth, 0.4 of the diameter as the width, and the above bridge card is applied.

(2) *Steel stringers (standard I-beams) with timber flooring.* The card below shows the safe gross load in tons for *one* steel stringer.

Span in Feet	Depth of Stringer in Inches								
	6	7	8	10	12	15	18	20	24
10	2.6	3.8	5.0	9.0	13.0	21.5	32.5	43.0	64.5
12	2.2	3.1	4.3	7.5	11.0	18.0	27.0	35.5	53.0
14	1.8	2.6	3.6	6.0	9.0	15.0	22.5	30.0	45.0
15	1.7	2.4	3.3	5.8	8.5	14.0	21.0	28.0	42.0
16	1.6	2.3	3.1	5.5	8.0	13.0	20.0	26.0	39.0
18	1.4	2.0	2.7	4.7	7.0	11.5	17.5	23.0	34.5
20	1.2	1.8	2.4	4.2	6.0	10.5	15.5	20.5	30.5
24		1.3	1.8	3.2	4.8	8.0	12.0	15.5	23.5
28		1.1	1.5	2.6	4.0	6.5	10.0	13.0	19.5
32			1.2	2.0	3.1	5.0	8.0	10.5	15.5
36				1.8	2.7	4.5	6.5	9.0	13.5
40					2.3	3.9	6.0	8.0	12.0

Figure 30. Wheeled vehicle bridge card (steel stringers).

Example: To determine the capacity of a 1-lane bridge which has six 10-inch standard I-beam stringers over a span of 20 feet.

Solution: At the intersection of the column for the depth of stringers of 10 inches and the column for a span of 20 feet, is found the figure 4.2 which is the capacity of one stringer. The actual

number of stringers is 6; therefore, the safe capacity of the bridge is 6 × 4.2 equals 25.2 or 25 tons.

Railroad rails. Standard railroad rails should be considered as 6-inch I-beams.

d. DATA USED FOR COMPUTING WHEELED VEHICLE BRIDGE CARDS. Safe unit bending stresses —2,100 p.s.i. for wood, 24,000 p.s.i. for steel. (For other data see FM 5–10.)

e. 3-INCH GUN MOTOR CARRIAGE. The following bridge cards may be used to determine the stringer requirements to carry the 3-inch gun motor carriage, M10, (weight 64,000 pounds) on a 1-lane bridge. They may also be used for the tank recovery vehicle.

(1) *Rectangular wooden stringers with timber flooring.* The card below shows the total *stringer*

Span in Feet	Depth of Stringer in Inches									
	6	8	10	12	14	16	18	20	22	24
10	91	52	33	23	17	13	10	8	7	6
12	132	74	48	33	24	19	15	12	10	8
14		98	63	44	32	25	20	16	13	11
15		113	72	50	37	28	22	18	15	13
16		126	80	56	41	31	25	20	17	14
18			97	68	50	38	30	24	20	17
20			115	80	59	43	35	29	24	20
22			132	92	68	52	41	33	27	23
24				104	76	58	46	37	31	26

Figure 31. Bridge card (wooden stringers). 3-inch gun motor carriage.

width in inches required to carry the 3-inch gun motor carriage, or the tank recovery vehicle.

Example: A 1-lane bridge has six 6-x-12-inch wooden stringers over a span of 14 feet. Will it carry the 3-inch gun motor carriage?

Solution: At the intersection of the column for the depth of stringers of 12 inches and the column for a span of 14 feet is found the figure 44 which is the total stringer width in inches required. The actual stringer width is 6 (number of stringers) × 6 inches (width of each stringer) equals 36 inches total width. Therefore, the bridge will *not* carry the vehicle. (To strengthen the bridge, two stringers are added or the span is shortened by adding a trestle bent or A-frame.)

Round stringers. For stringers of round timber, the diameter of the timber at the center of the span is considered as the depth, 0.4 of the diameter as the width, and the above card is applied.

(2) *Steel stringers (standard I-beam) with timber flooring.* The card below shows the total *number* of steel stringers required to carry the 3-inch gun motor carriages, or the tank recovery vehicle.

Example: A 1-lane bridge has six 10-inch I-beam stringers over a span of 20 feet. Will it support the 3-inch gun motor carriage?

Solution: At the intersection of the column for the depth of stringers of 10 inches and the column for a span of 20 feet, is found the figure 7 which is the number of stringers required. The actual number of stringers is 6; therefore the bridge will *not* carry the vehicle. (To strengthen the bridge,

Span in Feet	Depth of Stringer in Inches								
	6	8	10	12	14	16	18	20	24
10	5	3	2	2					
12	8	4	3	2	2				
14	10	6	4	3	2	2			
15	11	7	4	3	2	2			
16	13	7	5	3	3	2	2		
18	16	9	6	4	3	2	2		
20	19	10	7	5	4	3	2		
24		14	9	6	5	4	3	2	2
28		17	11	8	6	4	3	3	2
32		20	13	9	7	5	4	3	2
36			15	10	8	6	5	4	3
40			17	12	9	7	5	4	3

Figure 32. Bridge card (steel stringers). 3-inch gun motor carriage.

one stringer is added or the span is shortened by adding a trestle bent or A-frame.)

Railroad rails. Standard railroad rails are considered as 6-inch I-beams.

f. 76-MM GUN MOTOR CARRIAGE. The following bridge cards may be used to determine the stringer requirements to carry the 76-mm gun motor carriage (weight 38,500 pounds) on a 1-lane bridge.

(1) *Rectangular wooden stringers with timber flooring.* The card below shows the total *stringer*

width in inches required to carry the 76-mm gun motor carriage.

Span in Feet	Depth of Stringer in Inches									
	6	8	10	12	14	16	18	20	22	24
10	66	37	24	17	12	9	7	6	5	4
12	94	53	34	23	17	13	10	9	7	6
14	123	70	45	31	23	17	14	11	9	8
15		77	50	34	25	19	15	12	10	9
16		86	55	38	28	22	17	14	11	10
18		100	65	45	33	25	20	16	13	11
20		120	77	53	39	30	24	19	16	13
22			88	61	45	33	27	22	18	15
24			99	68	50	38	30	25	20	17

Figure 33. Bridge card (wooden stringers.) 76-mm gun motor carriage.

Example: A 1-lane bridge has six 6-x-12-inch wooden stringers over a span of 16 feet. Will it carry the 76-mm gun motor carriage?

Solution: At the intersection of the column for the depth of stringers of 12 inches and the column for a span of 16 feet the figure 38 is found, which is the total stringer width required. The actual stringer width is 6 (number of stringers) × 6 inches (width of each stringer) or 36 inches. The actual stringer width is less than that required, so the bridge will *not* carry the vehicle.

Round stringers. For stringers of round timber, the diameter of the timber at the center of the span is considered as the depth, 0.4 of the diameter as the width, and the above card is applied.

(2) *Steel stringers (standard I-beam) with timber flooring.* The card below shows the total *number* of steel stringers required to carry the 76-mm gun motor carriage.

Span in Feet	Depth of Stringer in Inches								
	6	8	10	12	14	16	18	20	24
10	4	2	2						
12	6	3	2	2					
14	7	4	3	2					
15	8	5	3	2	2				
16	9	5	3	2	2				
18	11	6	4	3	2	2			
20	12	7	5	3	2	2			
24	16	9	6	4	3	2	2		
28	20	11	7	5	4	3	2	2	
32	23	13	9	6	5	3	3	2	2
36		15	10	7	5	4	3	3	2
40		17	11	8	6	5	4	3	2

Figure 34. Bridge card (steel stringers). 76-mm gun motor carriage.

Example: A 1-lane bridge has six 10-inch I-beam stringers over a span of 24 feet. Will it carry the 76-mm gun motor carriage?

Solution: At the intersection of the column for the depth of stringers of 10 inches and the column for a span of 24 feet, the figure 6 is found, which is the number of stringers required. The actual number of stringers is 6; therefore, the bridge will carry the vehicle.

Railroad rails. Standard railroad rails are considered as 6-inch I-beams.

g. DATA USED FOR COMPUTING 3-INCH AND 76-MM GUN MOTOR CARRIAGE BRIDGE CARDS. Safe unit bending stresses—2,100 p.s.i for wood, 24,000 p.s.i. for steel; stringer efficiency 80 percent; impact 25 percent; dead load of 220 pounds per foot (weight of stringers neglected).

50. Towed Loads

a. GENERAL. In calculating the ability of a bridge to carry a towed load, two factors must be considered:

(1) The weight of each part of the load, that is, the weight of the towing vehicle and of the towed vehicle.

(2) The length of the two parts of the load in relation to the length of the span of the bridge.

b. SHORT SPANS. If the span of the bridge is short enough so that only one part of the load is over the span at one time, each part of the load may be considered as a separate vehicle.

c. LONG SPANS. When the span of the bridge is long enough so that both parts of the load will be on it at the same time, two rules apply:

(1) *Vehicles loaded to rated capacity.* The total weight consists of the weight of the heavier vehicle plus one-half the weight of the lighter vehicle. This principle applies because the two parts of the load will not be on the same spot at the same time.

(2) *Vehicles overloaded.* The combined weight of both vehicles should be considered as the load on the span.

Section XIII

DECEPTIVE MEASURES

51. General

a. Deceptive measures are frequently used in combat to mislead the enemy and to cause him to dissipate his fire. For example: chains, brush, or other improvised drags may be pulled behind vehicles to create a dust cloud resembling the movement of a large column. Bivouac areas may be simulated by creating tracks and signs of activity normally associated with such areas. Dummy installations and decoy positions may be constructed.

b. In the employment of deceptive measures it must be remembered that the enemy is smart. The positions must be logical, they must be constantly maintained, and the construction should be simple. The success of the work will depend on the resourcefulness and ingenuity of the men and their ability to use the materials available.

52. Dummy Gun Positions

One of the most effective deceptive measures is the dummy gun position. To construct such a position a log may be used to simulate the tube of a gun. The tracks, blast marks, and other signs of activity characteristic of a gun position should be created. The dummy should be placed in a logical firing position and should be partially concealed, leaving only those tracks and signs of activity which usually disclose position. It must

Figure 35. Deception as to size of moving column.

be remembered that it is not the indivdual decoy but the activity and characteristics of an actual position that will deceive the enemy.

53. Fougasse

Dummy gun positions may be made more realistic by simulating muzzle blast through the use of a fougasse. A fougasse that creates a fake muzzle blast similar to that of a 3-inch gun may be constructed by the use of two pounds of TNT to give a sound and flash similar to the gun firing and an additional ½ pound of TNT to blow dust out of a hole in the ground to give the effect of the muzzle blast. A fougasse is most effective if it is located in a logical gun position and should be fired while actual guns are firing.

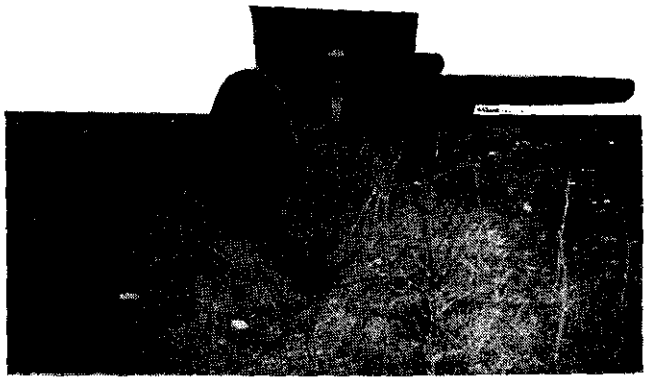


Figure 36. Dummy gun.

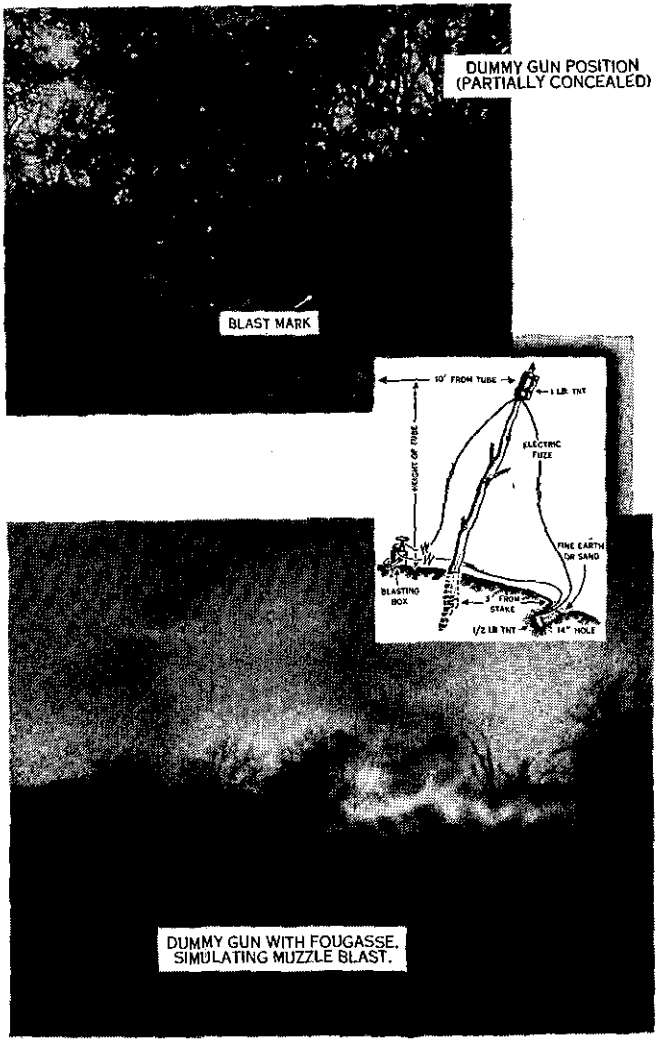


Figure 37. Dummy gun positions and fougasses.

Section XIV
MINE REMOVAL

54. Organization

a. When mines are encountered the pioneer platoon usually will be charged with breaching mine fields or removing scattered mines. However, it must be prepared to lift entire mine fields. These operations must be done rapidly and always with great care or excessive casualties will result. Therefore, all personnel must be organized and thoroughly trained and drilled in mine removal to further the rapid movement of the battalion.

b. The basic principles of mine field removal organization are contained in FM 5–31. The pioneer platoon, however, does not have as large an organization as is shown. Figures 38 and 39 outline an organization which is readily adapted for use by the pioneer platoon.

c. The breaching party is organized as follows:

	Officer	*NCO*	*Men*
Advance party	1	1	2
No. 1 party—taping	..	1	6
No. 2 party—detecting	..	1	8
No. 3 party—detecting	..	1	8
No. 4 party—reserve & supply	..	1	4
	1	5	28

Party duties. (1) The advance party indicates to the taping party the location of the starting tape and lays out the direction of the center tape

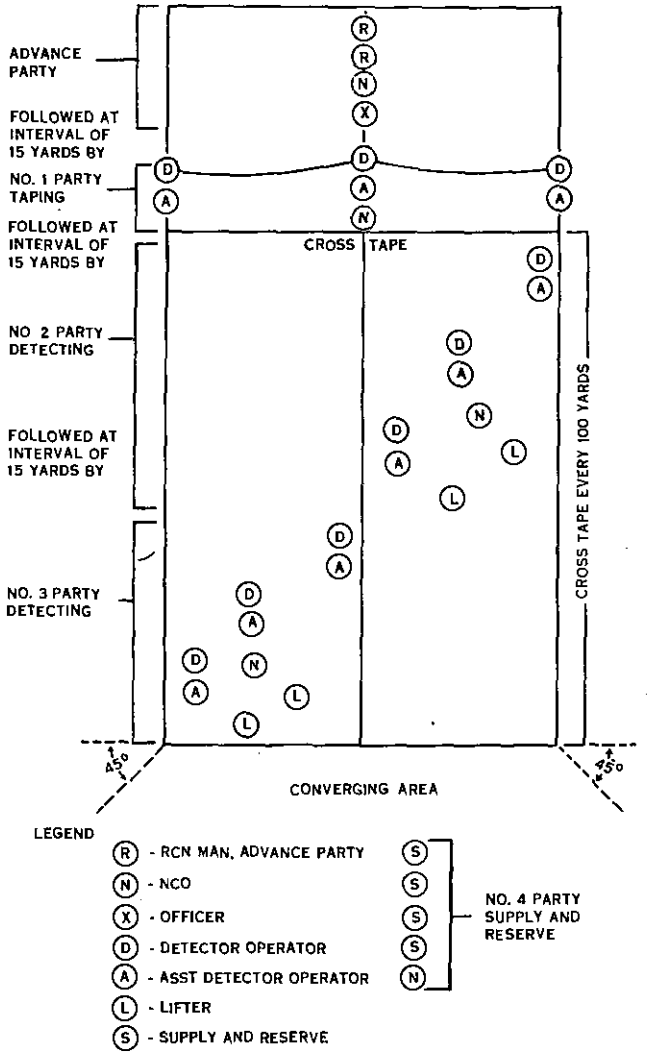


Figure 38. Mine removal organization of pioneer platoon.

ADVANCE PARTY

Personnel	Duties
1 officer	Officer supervises work of entire breaching party.
1 NCO	NCO directs advance party.
2 men	(1) Advance party selects best location for breaching. (2) Establishes starting line for No. 1 party. (3) Proceeds through mine field using mine detector, finds its outer limit and locates guide stakes or lights for No. 1 party. (4) Establishes location of cross tapes on way back.
Equipment	
Compass	
Stakes	
Marking lights	
Mine detector (from No 3 party)	

NO. 1 PARTY

Personnel	a. Lane Taping
1 NCO	Tapes two 8-yard lanes forward from base tape as follows:
6 men	Men Nos. 1, 2, & 3, taped together at 8-yard spacing, run out main tapes from base line, using electrical detectors to check ground immediately to front as they move forward (Fig. 38). Tapes may be run out from reels in special holders fastened to their backs, leaving their hands free. (Detectors operated within 8 yards of each other may cause interference which decreases their efficiency. In this case, the two side detector men drop back in line with the noncommissioned officer who follows 10 to 15 yards behind the center detector operator. The side detector men are taped to the noncommissioned officer to maintain proper 8-yard spacing.)
Equipment	
3 electrical detectors	
1,000 yards white tape in rolls	
Mine markers	
Compass	
Nails, 6d	
Pliers	

Men Nos. 4, 5, & 6, (assistants) follow, pin down tapes and cut them when required, place markers on mines found along tape lines, investigate, disarm and cut trip wires located by detector men, and run out cross tapes when ordered. Cross tapes are set at right angles to center tape, and extend 5-yards beyond lane-boundary tape.

Normally they are placed at approximately 100-yard interval to equalize clearing tasks. Several cross tapes are required for a deep mine field.

NCO in charge commands party and establishes proper direction of tapes.

Figure 31. Procedure for breaching a mine field by electrical detector.

b. Mine Detection

On completion of lane-taping, party returns along boundary tapes to assembly area and becomes a detector party, widening to a 16-yard lane, the 8-yard lane cleared by No. 2 party.

NO. 2 PARTY

Personnel
1 NCO
8 men

Equipment
3 electrical detectors
Mine markers
Wire

Mine Detection

As soon as taping party has advanced 15 yards, No. 2 party starts detecting forward from tape line in right hand lane.

Men Nos. 1, 2,& 3, operate electric detectors each sweeping 8 feet of frontage working in echelon at 15-yard intervals.

Men Nos. 4, 5,& 6, follow in rear as assistants and mark mines found. They exchange duties with detector operators at 20 minute intervals.

Men Nos. 7 & 8, disarm and lift mines, either by hand lift or by pull with a 50 yard wire or rope. Place lifted mines outside lane boundary tapes.

NCO commands party.

NO. 3 PARTY

Personnel
1 NCO
8 men

Equipment
3 electrical detectors
Mine markers
Wire

Mine Detection

When ordered, walks up center-line tape and starts detecting forward from cross tape in right-hand lane, using same procedure as No. 2 party.

On completion, returns down center-line tape to cross tape and starts widening lane it has just finished to 16 yards, unless No. 4 party is used to widen it.

NO. 4 PARTY

Personnel
1 NCO
4 men

Reserve and Supply

Replaces casualties in men and losses in equipment.

Unloads and distributes lane-marking supplies.

Erects lane markers.

Checks for mines in converging approach to lane.

Maintains communications.

Figure 32. Procedure for breaching a mine field by electrical detector.—Continued.

by magnetic azimuth. This detail also locates all cross tapes.

(2) No. 1 party, using tape, marks out two 8-yard lanes from the base tape. It becomes a detector party on completion of lane taping.

(3) No. 2 and No. 3 parties each clear a single 8-yard lane.

(4) No. 4 party is in reserve and assembles supplies.

55. Location of Mines

The mine removal organization uses the mine detector to locate individual mines. If mine detectors are not available or are out of order, the hand search method is employed. Definite organizations for this method will be found in FM 5–31 and may be varied for use by the pioneer platoon. In the event that non-metallic mines have been buried in the mine field, a probe must be used to locate them. The probing should be done gently and at an angle of 45 degrees, being certain to cover every six inches of ground.

56. Removal of Mines

A simple method of mine removal is to pull them out by means of ropes. When the mines are located, the removers attach short lead ropes to the handle, fuze, or cover of each mine. The short lead ropes are then attached to a main rope so that several mines may be pulled at once. Lead ropes should be of such length that when main rope is pulled the most distant mines will be pulled first, followed successively by those toward the pullers. This method prevents cutting of ropes

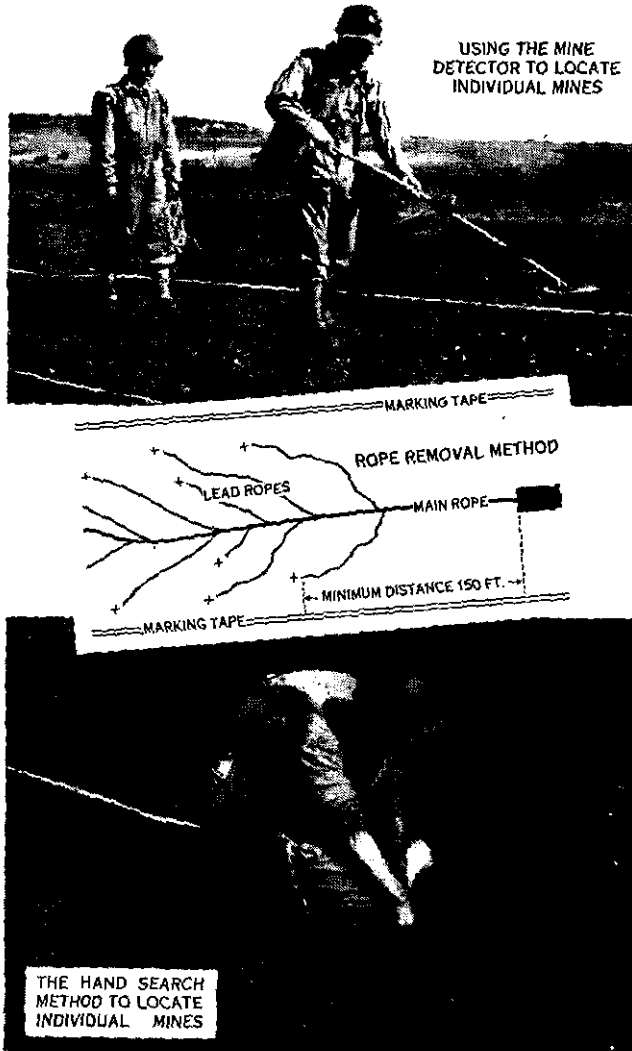


Figure 40. Locating and removing mines.

leading to more distant mines by the explosion of mines closer in. Care should be taken to allow sufficient slack in each lead rope so no mines will be actuated while the ropes are being attached. The main rope should be at least 150 feet long so that the mines may be pulled from a safe distance either by hand from a sandbagged prone shelter or other suitable cover, or by tying the rope to an armored vehicle.

Section XV
BOMB AND ARTILLERY DUD DISPOSAL

57. General

a. Unexploded shells or aerial bombs may be found in areas occupied or to be occupied by the battalion or on routes where they cannot be detoured. When possible, the bombs, or shells will be left undisturbed. When a possible time bomb is located in a position which cannot be detoured, the bomb is marked and a safe area of 300 yards in diameter designated. No personnel or vehicles will enter the area until the bomb is disposed of.

b. If necessary, shells and bombs may be destroyed in place by the pioneer platoon. All vehicles and personnel will be moved to cover, or, if no cover is available, to a distance of at least 500 yards from the dud. *One* man will then place a small explosive charge against the dud, being careful not to move or disturb the projectile in any way.

58. Explosives Needed

The amounts of explosives necessary to destroy various sizes of artillery shells are given below. The same figures can be applied to the destruction of bombs or mortar shells by comparing the diameter of the dud with that of the artillery shell and using the corresponding amount of explosive.

Caliber of Shell	*Pounds of TNT*
37-mm, 2.24-inch	1
75-mm, 2.95-inch, 3-inch	1
155-mm, 4.7-inch, 6-inch	2
244-mm, 8-inch, 9.2-inch	2
10-inch, 12-inch	3
14-inch, 16-inch	3

Figure 41. Placing charge to destroy dud shell.

NOTE. Three ½-pound blocks of TNT are shown. If 1-pound blocks are issued, use two.

Section XVI

ESTIMATION OF DEMOLITION CHARGES

59. General

a. The pioneer platoon may be called on to execute demolitions. These projects will vary because of the material, structure, weather conditions, and similar factors; therefore it is not possible to provide a set of rules that will cover all possible conditions. Any rules may be considered as guides and should be tempered by the results of test shots, past demolition experience, and existing conditions.

b. While formulas (FM 5–25) are used to determine accurately the amount of explosive necessary to accomplish demolition tasks, it is not intended for the pioneer platoon to execute large scale demolitions. For this reason simple rules that can be easily remembered and applied are better suited to pioneer platoon work even though somewhat excessive amounts of explosion may be used in some instances. The following paragraphs present some general information on demolitions relative to tasks that the platoon will normally perform. It supplements the elementary principles on the use of explosives in FM 21–105. For information on more extensive demolition tasks, see FM 5–25.

c. When TNT is issued in 1-pound blocks instead of ½-pound blocks they can be sawed in half and used according to figure 42 and the rules given below. If the 1-pound blocks can be made

up into a charge of approximately the same dimensions as that required when using ½-pound blocks, the 1-pound blocks can be used without cutting.

60. Steel

To cut steel members by the use of explosives the most important principle to remember is that the explosive charges must be held in close contact with each other and with the steel to be cut. The amounts of explosive required to cut the various shapes of steel can be determined roughly by the simple rules outlined below—

(1) *Rods.* One pound of explosive is used for each inch of diameter. This rule applies for rods up to four inches in diameter.

(2) *Small rectangular bars.* One pound of explosive is used for each inch of thickness and each two inches of width of the widest side of the bar. The explosive is placed on the wide side. For example, a bar 1 inch x 4 inches x 10 feet requires two pounds of explosives placed on the 4-inch side.

(3) *Small built-up box girders.* The inside portion of the girder is filled with a tier of explosives.

(4) *I-beams.* One side of the I-beam is filled between the flanges with a tier of explosives.

61. Timber

The amount of explosive necessary to cut timber is obtained by using the formula—

$$P = \frac{D^2}{40}$$

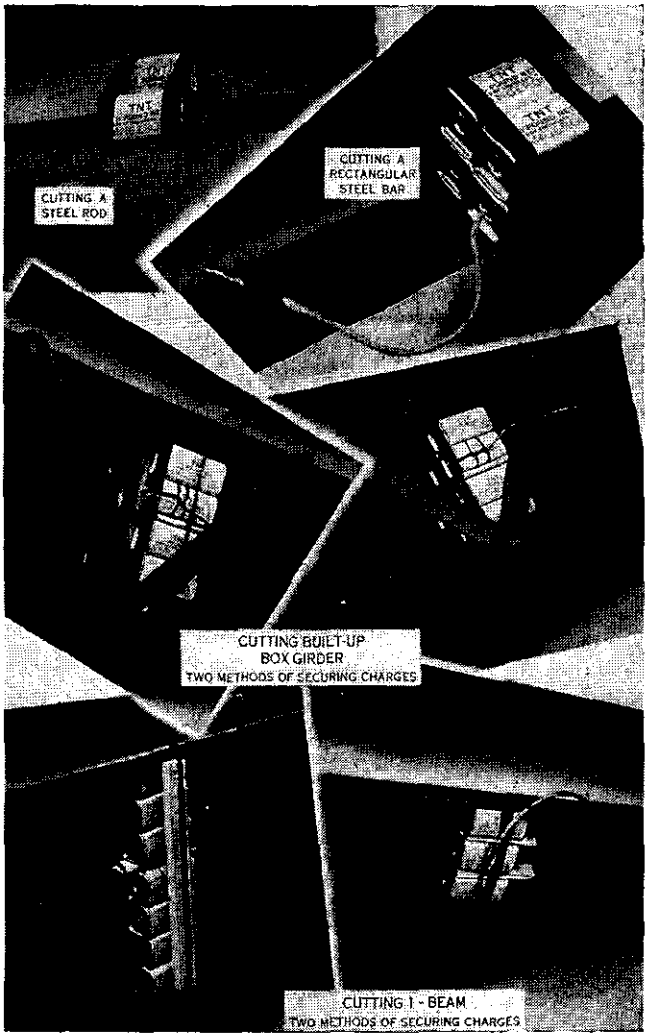


Figure 42. Cutting steel members with explosives.

Note. This figure shows use of ½-pound blocks of TNT. When TNT is issued in 1-pound blocks they may be sawed in half and made up in charges as illustrated above.

P equals the number of 1-pound blocks of TNT.
D equals the diameter of round timbers or the *smallest* dimension of rectangular timber in *inches.*

(1) *Example:* How many 1-pound blocks of TNT are required to cut a log 10 inches in diameter?

(2) *Solution:* $P = \frac{12 \times 12}{40} = 3.6$ pounds. (Use four 1-pound blocks of TNT.)

62. Concrete

The amount of explosive necessary to destroy *one* reinforced concrete stringer in a span of a reinforced concrete bridge is obtained by using the formula:

$$P = 3H^2T$$

P equals the number of 1-pound blocks of TNT.

H equals the height in feet.
T equals the thickness in feet.
} Minimum value of one (1) foot.

(1) *Example*: How many 1-pound blocks of TNT are required to destroy a reinforced concrete stringer 2 feet high and 10 inches thick?

(2) *Solution:* $P = 3 \times 2 \times 2 \times 1 = 12$ (twelve 1-pound blocks of TNT)

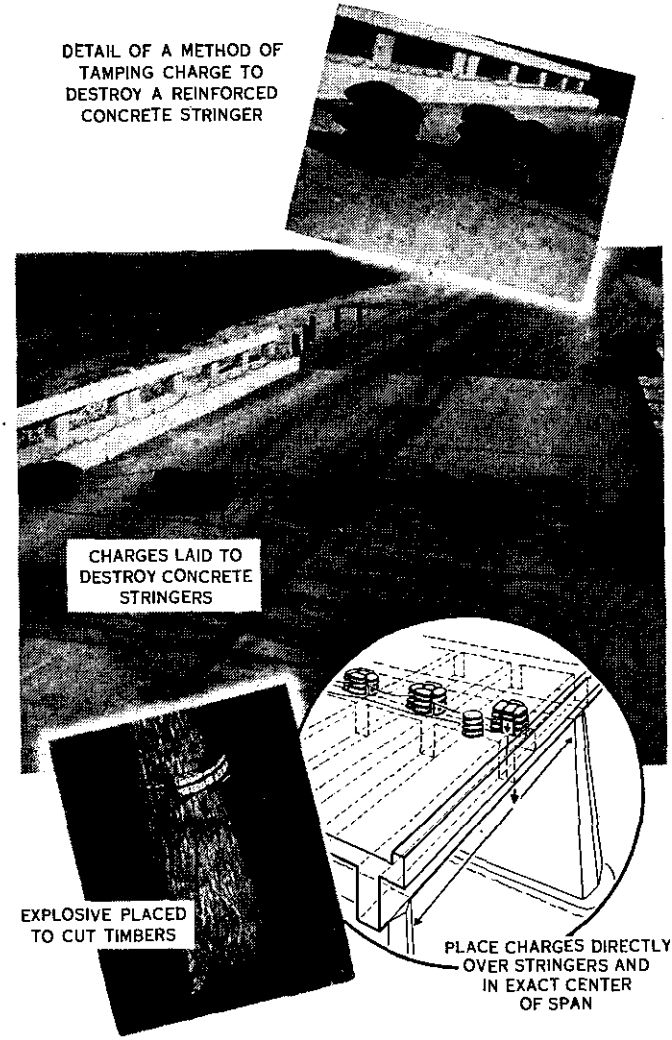


Figure 43. Destroying reinforced concrete stringer and timber with explosives.

63. Craters

a. To form a crater in a road, holes are dug in a line across the road extending to natural barriers on both sides. The holes should be 5 feet apart from center to center. The charge necessarily will vary with the condition of the ground; a normal charge is 10 pounds of explosive per foot of depth in each hole. For example, 50 pounds of explosive will be placed in the bottom of a hole 5 feet deep.

b. The explosive should be tamped *well* with earth, mud, or water. The charge should be primed by two methods to insure simultaneous detonation of all charges. This will avoid the necessity of digging up the charges or placing new charges in case the charge fails to detonate.

c. At times culverts will be found in locations advantageous for road craters. A culvert may be utilized in blowing a crater by observing the spacing of charges and the amount of explosives per charge as outlined in *a* above. This procedure is effective where the distance from the surface of the road to the top of the culvert does not exceed five feet. When distances greater than five feet are encountered, other considerations enter which make the amount of explosives required too great for use by the pioneer platoon. The ends of the culvert must be blocked and well tamped.

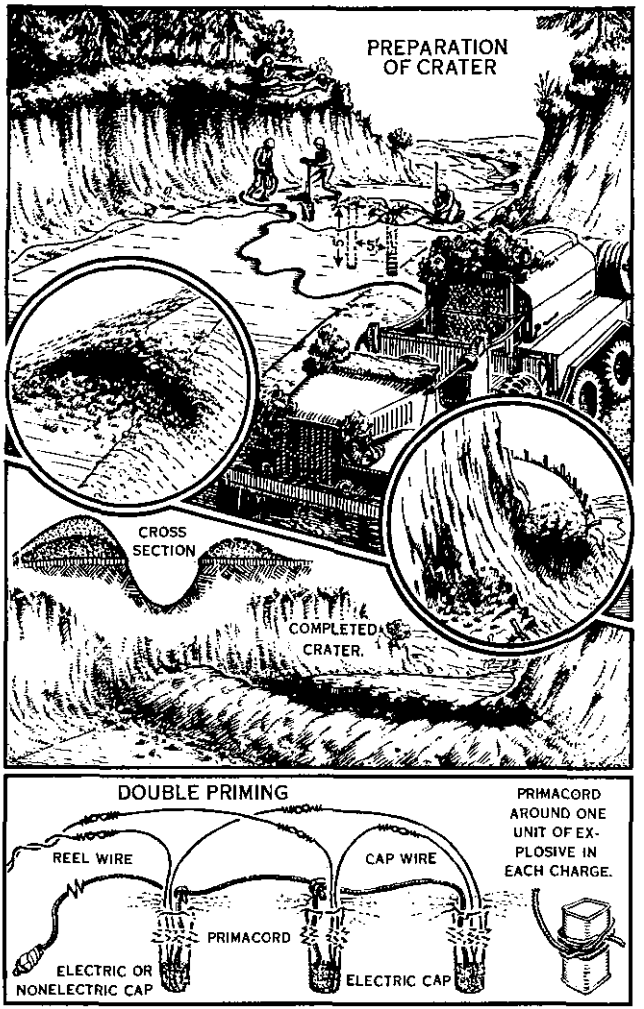


Figure 44. Preparation of craters.

INDEX

☆ U. S. GOVERNMENT PRINTING OFFICE: 1944—613837