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15 DECEMBER 1943

Germany, Heer, Oberkommando

**GERMAN
WINTER WARFARE**

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PREFACE

This work is substantially a translation of an enemy document which has been edited in the style and format of War Department publications and rearranged in order to present the material in a more logical order than in the original text. All of the illustrations, which were rough sketches in the original, have been redrawn and have been improved as much as possible.

The handbook was based on the experiences of the German Army during the first two winters of the war in Russia. Essentially it tells a story of efforts to solve two vital problems of winter warfare: mobility and shelter. The handbook was published by the German High Command on 5 August 1942, apparently in a great hurry, in order to help the German forces to prepare for a third rigorous winter on the invaded territory of a formidable foe. The material, evidently collected from the various branches of the German Armed Forces, was put together badly and in some places was almost unintelligible. A considerable portion of the material was in the form of appendices under headings that duplicated section captions in the main text. These appendices have been merged into their logical places. Some material which had no special application to winter warfare was eliminated.

While the handbook was badly arranged, the material itself is considered to be valuable for the insight that it gives into the experiences of an Army under conditions of extreme cold and for its reflection of the degree of improvisation to which the German Army was compelled to resort. The numerous references to "makeshifts," "expedients," and "improvisations" point to the lesson that the problems of winter warfare must be considered and solved long

before a force is committed to winter combat. In the manual the German High Command repeatedly emphasizes the lesson that equipment, methods, techniques, and clothing must be specially designed for the struggle against snow, ice, mud, moisture, and bitter cold. Above all it emphasizes the lesson that the individual soldier must be specially acclimated, trained, and toughened to fight in winter and that he must develop the will to resist its hardships as determinedly as he should resist the enemy.

In paragraph 4, "Preparation for Winter Warfare," the manual asserts: "In building up endurance against the rigor of the Russian winter, mental discipline is the determining factor." Again in paragraph 6, "Morale," the manual states: "The coming winter will again severely tax the spiritual stamina of the soldier. All suitable means, commensurate with the situation and combat conditions, will be employed to bolster his inner resilience."

It will be noted that the German High Command does not consider winter as a fixed season of snow and low temperatures. Before and after the winters in Russia there were periods which in most respects raised practically the same problems as snow and cold. The rains of autumn and the thaw in spring brought floods and mud, which, like deep snow, tended to immobilize the German forces on the long Eastern Front.

The text of the *Trachtenbuch für den Winterkrieg* begins in Section I. The "Foreword" and other preliminary matter of the German original are also included in order to emphasize the fact that this publication is a translation of a German manual intended for German troops. It is not a manual for U. S. troops, but must be read as an enemy document which is intended to convey information about the enemy's doctrine, techniques, and methods.

Anhang 2 zur H. Ds. Ia
Seite 18a ffd. Nr. 17

**Tafelbuch
für den Mineralreich**

Donn. 5. August 1942

Title page of original.

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Verso of title page of original.

**HANDBOOK
ON
WINTER WARFARE**

4 August 1942

(Translation of title page of original)

Army High Command
Army General Staff/Training Section (II)
No. 2300/42

Hq, Army High Command, 5 August 1942

The *Handbook on Winter Warfare*, a compilation of experiences gleaned from the Winter War of 1941-1942, is hereby authorized. It will serve as a suggestion for training.

By command of:
HAJDER.

(Translation of verso of title page of original)

FOREWORD¹

This handbook is a compilation of practical experience in winter warfare. It is intended to facilitate adaptation to winter conditions in Russia.

Section I gives a general idea of conditions during the winter and the mudding period and of the inferences which may be drawn therefrom. It is intended chiefly for officers of all grades.

The information in this handbook must become the common property of the troops, and a detailed study of it must be made the duty of all officers and instructors. Most of the subjects are suitable for the instruction of noncommissioned officers.

For the more intensive study of the subject of winter warfare, other training publications as well as training films will be used extensively.

¹Translation of foreword of original.

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Section I. WINTER, MUD, AND THAW

1. INFLUENCE OF WINTER

The Russian winter brings long-lasting, severe cold (-40 to -58 degrees F.) punctuated by short periods of thaw, snowfalls, storms, and fogs. During the cold months daylight often amounts to but a few hours a day.

In winter, variations in temperature and precipitations exert great influence on the nature of terrain and the mobility of troops. During the early part of winter, severe frosts before snow begins to fall, make it possible to cross otherwise impassable terrain. Rivers and lakes freeze and may be crossed by vehicles, but swamps which are under a blanket of snow usually have only a thin and weak ice surface. The effect of snow and freezing temperatures varies with local conditions, but generally snow can immobilize wheeled and tracked vehicles of all kinds except on first-class roads.

Even a light snowfall, piled into snowdrifts by the wind may lead to serious traffic difficulties. Drifts may begin to form early in winter and they may pile very high, especially on the great steppes. Visibility is usually good in clear, frosty weather, and noises carry to great distances. An overcast sky makes observation difficult. Exact terrain appreciation and target designation may become impossible, because elevations and depressions show up only slightly and serious errors occur in estimating distances.

2. DURATION AND NATURE OF SNOW

In European Russia, snow blankets the terrain for about 4 months in the south (the Ukraine and the lower Volga); 4 to 6 months in the central region (Moscow area); and 6 to 7 months in the north (Archangel). The first frosts appear at the beginning of October. The depth of the snow varies with the terrain. The wind sweeps the snow away from open and flat surfaces and heaps it up in front of obstacles and in hollows. In woods it is distributed evenly in depth. An average of 4 to 16 inches may be expected in southern Russia, in the central region and in northern Russia, 20 to 29 inches. Local snowdrifts 6 feet 6 inches to 9 feet 10 inches high are not rare.

The soldier who is unaccustomed to winter conditions, particularly the conditions of winter warfare in Russia, ought to know not only the disadvantages of snow, but also the advantages which it affords and which he may exploit. Snow, when properly employed, provides shelter against cold and wind, yet it is porous enough to permit ventilation in snow shelters. When it is packed sufficiently thick (3 meters or 9 feet 10 inches), snow affords protection against enemy fire. It is also good camouflage.

In slightly cold weather falling snow consists of large crystals or flakes and forms a loose surface, but in severe cold it falls in fine grains. Wind packs snow hard. A hard crust on top, soft snow assures mobility, but if the crust is not strong, it becomes a disadvantage. Breaking through such a crust is strenuous for foot soldiers and often dangerous for skiers. Horses may injure their hoofs and dogs their paws. The carrying capacity of snow crusts varies with the temperatures at different times of the day; on sunny days it is likely to weaken considerably.

3. SEASONS OF MUD AND THAW

Heavy autumn rains or snowfalls and the melting snow and floods of the spring thaw also make roads virtually impassable. The first period of mud begins about the middle of October and is frequently terminated by biting frost (in the winter of 1941-42 by a temperature of -5° degrees F.) or by snowfalls. The spring thaw period, beginning in March in southern Russia and progressing northward, brings another spell of mud. In some parts of the country the thaw causes gigantic floods. Temperature, wind, and ground consistency as well as rain and snow are factors which determine the extent to which roads vanish. Light soil, especially sand, permits water to drain off, but the dark humus of the Ukraine turns into well-nigh untraversable, sticky mud.

Wheeled and tracked vehicles are unable to use unpaved roads and highways while the ground is mire. Paved roads which cross depressions, as well as combat positions with deep foundations, may be flooded temporarily. All bridges which are not sufficiently anchored may be damaged or destroyed by floods and floating ice. Airplanes may be limited to airdromes with concrete runways.

It is just as important to maintain the mobility of troops during thaws as it is while snow is on the ground. Positions must be improved and made mud-proof, and they must be stocked to make them independent of supply lines for extended periods (3 to 4 weeks). Unpaved roads must not be used until they have thoroughly dried out. The possible gain in traveling time is out of proportion to the long time and considerable labor that is necessary to recondition such roads. Special roads must be constructed for use during

the muddy period, and measures must be taken to make the normal road net serviceable as soon as possible.

Wheeled motor vehicles should be prohibited on muddy roads, and tracked vehicles should be employed only in emergencies. Heavy wheeled vehicles or sleds should be replaced by light carts, high two-wheeled vehicles, boat sleds, or pack animals. If it is impracticable to secure bridges against floating ice and floods, they should be dismantled and supplanted by a ferry service.

Where necessary, units should move to positions free of mud, or construction material should be stocked for the improvement of existing positions. Drainage ditches and sewage shafts should be dug within them. Wounded men and unserviceable mounts must be evacuated promptly. Ammunition, rations, fodder, and heating and illuminating equipment must be stored in advance in dry places. The heavy winter clothing and footgear of the troops must be replaced by articles suitable for wet weather.

4. PREPARATION FOR WINTER WARFARE

Experience teaches us that the German soldier knows how to master the difficulties of the Russian winter, and that he is superior to the enemy even in winter. He is capable not only of defending himself against the Russian but also annihilating him in attack.

Prerequisites for this superiority are as follows: psychological preparation for the hardships of winter warfare, appropriate training and adaptation, familiarity with winter combat methods, and proper equipment and employment of expedients.

In building up endurance against the rigors of the Russian winter, mental discipline is the determining factor.

Many cases of freezing are caused by a slackening of attention and by indifference. The danger of freezing is especially great when one is exhausted after great exertion or after a long period on guard. Then the soldier must summon all his will power in order to keep awake and alert. The code of comradeship demands that soldiers must assist each other in this effort and in stimulating the will to live. The most serious danger begins when confidence in one's own strength is extinguished.

The aim of training must be to convey to the soldier all the knowledge he will need for survival and combat in winter. His field training must condition him to endure extremes of cold, moisture, and snow. His training will include the following important subjects:

- a. Protection of the soldier, horse, vehicle, weapons, and equipment against cold and snow.
- b. Training—hardening and conditioning that will enable the soldier to live in the simplest types of bivouac structures and improvised shelters of his own construction instead of permanent shelters.
- c. Mobility—training in skiing; conversion of wheeled vehicles into sleds (winter mobility of anti-tank guns is especially important); clearing existing roads or building winter roads, and making ice crossings; movements in winter terrain on foot, skis, and sleds, and in motor vehicles.
- d. Construction of positions and obstacles in frozen ground and snow.
- e. Firing and combat in severe cold and deep snow, combat on skis, scouting, patrolling, and camouflage.

There are no special "winter tactics." The hampering effect of deep snow, however, greatly influences the combat methods of normally organized and equipped troops. Ski troops and troops equipped with light sleds take over the missions assigned in temperate seasons to mobile troops (motorized, mounted, and bicycle troops). (The special characteristics of combat in winter are discussed in par. 5, "Winter Combat Methods," p. 7.)

The clothing and equipment intended for winter warfare must afford not only comfort but freedom of movement for combat, and especially for attack in severe cold, deep snow, and strong wind. If supplies issued to the unit are not sufficient, they must be augmented by improvisations and substitutes of all kinds. The ingenuity of the individual soldier and of the leader in contriving makeshifts keeps the unit efficient and reduces casualties.

The following are basic requirements for clothing, equipment, and weapons in winter:

a. Clothing should not be too warm, but it must be windproof. It should permit quick movements (jumping, creeping, shooting). Extra underwear for changing after sweating, and additional warm clothing (such as a snuover sweater), should be carried for wear during rest periods and bivouacs.

b. Camouflage suits should be supplied at least to patrols and sentries. If such suits are not available, they must be improvised.

c. Footgear is especially important. Felt boots are best, but they must be kept dry. Keep the uppers of leather boots from freezing hard by wearing overboots or cloth covers over them. In addition, paper and foot cloth (see par. 44) should be strapped on the feet in addition to socks. Footgear must be roomy enough to permit moving the toes.

d. Bivouac equipment makes one independent of permanent shelters. Cloth tents of the Finnish type (see par. 24) are the best, but in emergencies, shelter halves (which may also be used as ground sheets) will do. The equipment should also include plywood shelters, portable stoves, and individual cooking utensils so that the men can cook their own food.

e. Skis should be provided for all troops, scouts, messengers, and signal and medical personnel of all ranks. These classes of personnel should also be provided with felt boots and overboots, possibly, otherwise with laced shoes. Snowshoes may be used as substitutes.

f. Sleds must be substituted for most wheeled vehicles. The sleds must be light, and of standard width, and horses should be harnessed one behind

¹ Canvas covers which fit over German leather boots (see par. 64d, p. 196). Oversized pairs are often worn so that straw can be packed in for added warmth.—EDITOR.

the other (tandem). Field kitchens and heavy weapons must be loaded on sleds or runners (see pars. 65 and 66).

g. Snow-clearing equipment is needed to facilitate movement, especially off the roads. Snow plows should be provided or improvised.

h. Weapons must be mobile, and therefore their weight and caliber must be limited. They must be in condition to fire in any weather. For close combat, many automatic weapons are needed, but it is better to have an abundance of ammunition rather than a large number of weapons with only a limited supply of ammunition.

i. Individual motor vehicles, tanks, and assault guns are often valuable aids in winter combat and must be ready for operation in any kind of weather. Snow must be cleared to facilitate their movement.

j. Medical equipment must be provided in greater quantities than in other seasons. Provisions must be made for adequate transportation of the wounded, even in front lines, and for protecting them against cold.

5. WINTER COMBAT METHODS

Troops must not be deprived of their freedom of action in winter, no matter how inclement the weather. They must try in every possible manner to attack the enemy, to damage his installations, and to destroy him. Mobility on the battlefield and the ability to deceive and outwit the enemy give even a numerically weaker force a feeling of superiority.

The ability to carry out a march in winter may be the basis for the successful outcome of a battle. If possible, the enemy must be surprised, and surprise is more likely if the troops avoid highways and roads and move across terrain which is considered impassable. Experience has shown that enemy resistance is weakest in terrain that he considers inaccessible, and that cross-country marches frequently permit envelopment of his position.

The enemy is particularly susceptible to attack on his flanks and rear. A frontal attack is very difficult in deep snow, even when it is executed on skis.

In winter the systematic preparation and disposition of forces for combat are even more important than in summer, and require more than twice the time. All heavy-weapon vehicles and tanks must be employed to cut roads (see fig. 1). Probable weather conditions must be taken into consideration in preparing for these activities. Continuous attacks are a proved method of winter combat. They deprive the enemy of breathing spells, throttle his supply lines, prevent him from making fires to warm himself, and force him to

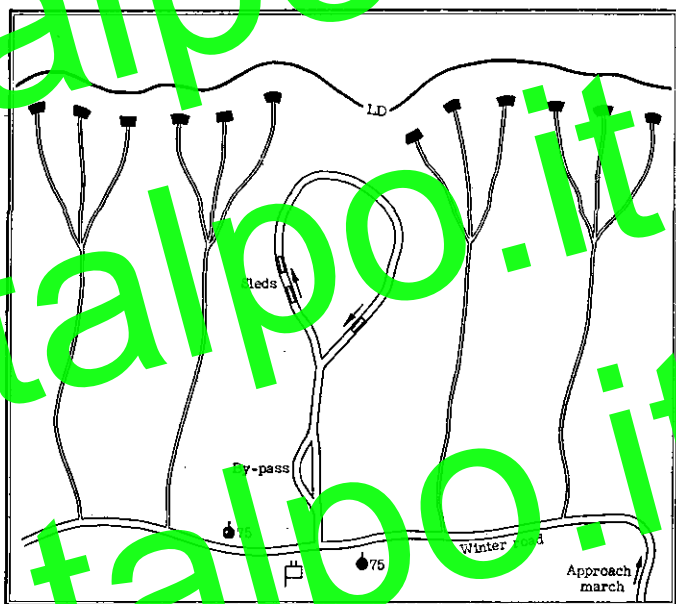


Figure 1.—Sled cutting trails and roads in an assembly area. (Sequence of activities: (1) make trails and roads to positions at the line of departure (LD); (2) bring heavy weapons, including artillery, into position; (3) move up the infantry as far as possible on skis or on foot along the trails.)

make frequent counterthrusts. Thus the fighting strength of the enemy is sapped without appreciably weakening our own forces, and he will be incapable of employing his own numerical superiority.

For this purpose, even weak but mobile forces may be employed. They may be specially formed units, patrols, or raiding parties. It is their mission to attack the enemy on all sides and to harass him during the night and in misty weather, and in terrain in which observation is difficult, particularly in wooded areas.

As a breakthrough into enemy lines and close combat are very difficult and costly, especially in deep snow or in terrain which cannot be reconnoitered easily, it is advantageous to isolate enemy forces by cutting their external communications. The enemy then must attack in order to extricate himself, and this action compels him to move into deep snow from quarters which protect him from fire and cold.

Troops must frequently dig in rapidly, even in deep snow and hard ground, after they have advanced their attack to points within range for machine-gun and rifle fire. Thus they will have cover against fire and protection against cold and will be able to install themselves adequately for defensive action against counterthrusts. If they lie around unprotected in open terrain for long periods, they will suffer heavy casualties from enemy fire and the cold weather.

Organizing for defense in frozen ground or deep snow requires much time and labor in order to construct obstacles and prepare for the commitment of reserves along tracks leading into the probable operation areas (see fig. 2). Experience has proved that the main line of resistance must

be held as an uninterrupted line, particularly at night and in hazy weather, in order to prevent infiltration by the Russians. It is necessary, however, to establish several strong-points. Active reconnaissance and aggressive conduct of operations serve as protection against surprises. The enemy who has broken through is repulsed by counterattack before he can gain a foothold. The Russian is very fast at digging in to the snow.

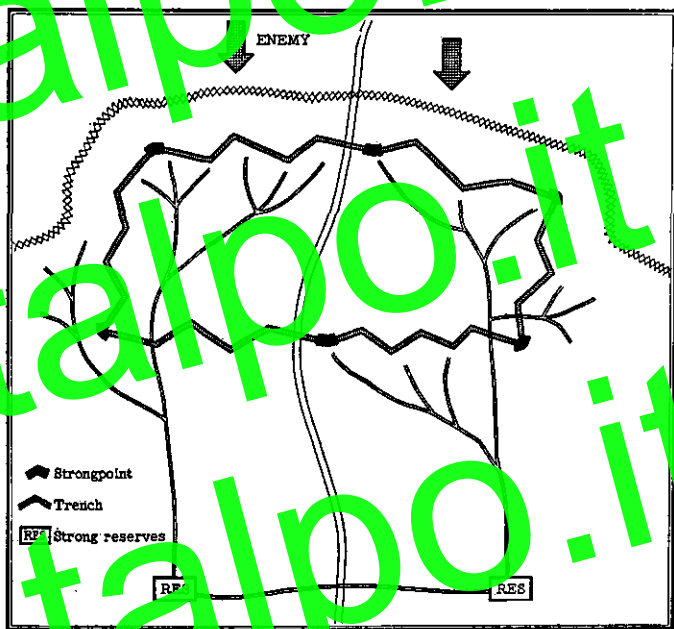


Figure 2.—Prepared trails in a defensive position. (The strong-points are connected by communication trenches; strong reserves are held back for a thoroughly rehearsed counterattack on the prepared trails.)

Valleys and ravines, which the Russians favor as approaches, must be blocked with obstacles and must be secured by adequate forces. Steep slopes must be utilized as tank obstacles. Terrain which is impassable during the summer months, swampland, and bodies of water lose their effectiveness as obstacles in winter. This point must be especially considered in laying out defensive positions at the beginning of winter.

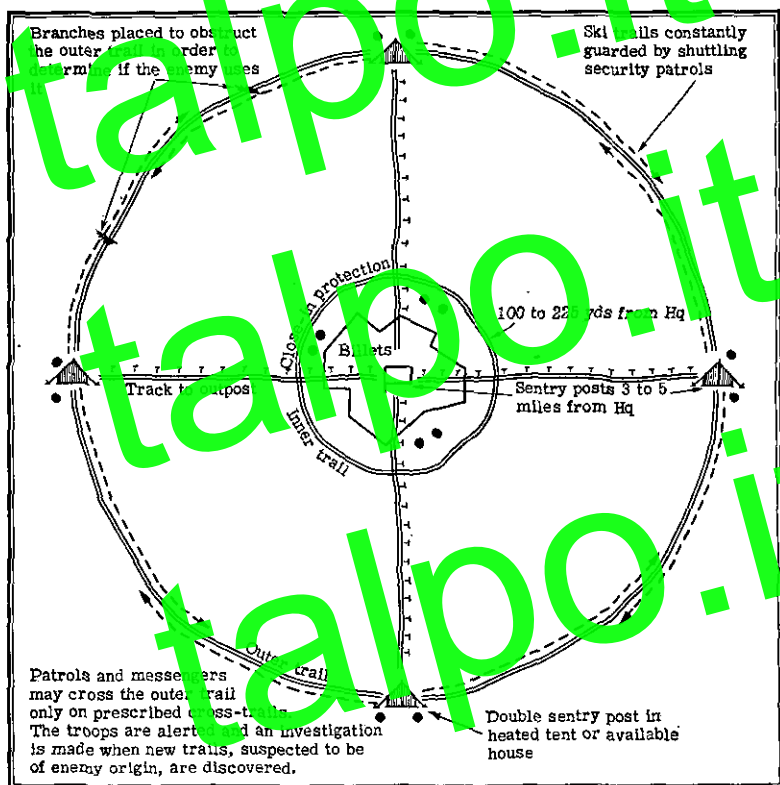


Figure 3.—Circular trail for the security of a winter position.

Wide fronts and troops in rest camps are protected by strongpoints or stationary patrols, as well as by a great number of light mobile patrols (if possible, on skis). Around billets and bivouacs a circular trail is the most effective security measure (fig. 3).

6. MORALE

a. General

The coming winter will again severely tax the spiritual stamina of the soldier. All suitable means commensurate with the situation and combat conditions will be employed to bolster his inner resilience. The example of the soldier, especially the officer who has proved himself in all situations, is a determining factor in maintaining the morale of the troops. Eagerness for action and good discipline must be maintained, especially behind the lines. Prerequisites in securing morale are consideration for the welfare of troops, tolerance shelter, and adequate provisions. Winter equipment, lighting facilities, and fuel must be procured in advance or substitutes provided. Important! Stimulate the initiative of troops. Shows should be staged and soldiers encouraged to participate in them. Intelligent organization of spare time is the best means of preventing useless brooding, summer-mourning, and disciplinary offenses.

The welfare of troops in the lines has priority. Morale-building supplies for the front must actually reach the front lines. There must be no pigeonholing in depots, railroad stations, headquarters, or orderly rooms. Checks against delay must be made continually. Commanders and head-

quarters must be in constant communication with field offices of the High Command of the Armed Forces.

b. Recreational Aids

(1) *Reading material.*—Do not leave newspapers lying around. Newspapers, bulletins, and magazines must reach the front fast. There the soldier is waiting for recent news. Papers of occupied territories should be sent forward because they do not have to be transported far. Front papers of both armies also serve the purpose of inculcating combat doctrine in troops.

Exchange of library kits between battalions and regiments should be encouraged. Field library kits of the Army Book Service (*Heeresbücherei*) are exclusively for front-line troops. Rear echelons and higher headquarters are normally equipped with Rosenberg libraries.

“Information for Troops” (*Mitteilungen für die Truppe*) continues to be distributed through the Army Postal Service (*Feldpost*) to divisions, two copies per unit. Report immediately any failure to receive copies. This also applies to “Information for the Officer Corps” (*Mitteilungen für das Offizierkorps*).

(2) *Lectures.*—Important lectures by speakers from the High Command of the Armed Forces are possible only under quiet conditions and after long preparation. Lectures by members of units on general cultural subjects (history, geography, travel, economics, engineering, fine arts) have been successful even in small units. The units themselves have good men for this purpose!

(3) *Radio.*—The Army radio receiving set has worked even in winter on the Eastern Front. The further issue of

sets and spare parts, on the basis of current production, is confined to front-line troops and is carried out only through higher signal officers of signal regiments. Production and distribution of additional sets and spare parts is being stressed. Rear installations and welfare organizations are equipped with commercial receivers.

(4) *Movies.*—Theaters are improvised behind the front lines on the basis of experience. The increase of available machines, especially of the projector unit with direct-current generator for localities without power supply, is desirable. Pictures shown are coordinated by the division G-2 (*War Division*).

(5) *Employment of "Strength through Joy" groups.*—On the Eastern Front only tours by small acting troupes are ordinarily possible. Transportation and shelter must be considered. When constructing new motion picture theaters, provide stage facilities for acting troupes. The stages will also be used for official business (lectures, instruction, briefing schools, etc.)

It is important to employ "Strength through Joy" groups (*KdF-Gruppen*) according to plan. Provide them with transportation facilities, cooperate with them, pay attention to their welfare, and provide for their security in guerrilla territory.

(6) *Competitions.*—Competitions are particularly valuable in all respects. New facilities have been provided for the winter of 1942-43. Important activities in this field are inventions and improvements of arms and equipments.

(7) *Improvement of quarters.*—The troops should be urged to improve their quarters by their own handiwork. Arts and crafts have a place in the construction of shelters. In view of the bare-minimum shelter conditions in the east,

this is particularly important. Encourage by competitions the improvement of quarters, moving-picture halls, theaters, kitchens, storerooms, stables, and gardens.

(8) *Organization of spare time.*—In organizing spare time, schools for choir leaders are particularly valuable. Train choir leaders for the units of divisions and regiments. Also encourage hobbies, crafts, and amateur theatrical performances by and for the troops. Occupational and through correspondence courses and civilian work groups is also successful. This kind of instruction has practical value for the future of the soldier.

(9) *Service centers.*—Service centers should be especially promoted. Unattractive living conditions and the lack of “places to go” and restaurants on the Eastern Front must be remembered. The establishment of numerous service centers is necessary. At larger service centers a senior hostess and several junior hostesses of the German Red Cross (*DRK*) must be assigned.

(10) *Troop convalescent camps.*—These are successful without exception. Convalescent camps behind front lines meet an urgent need of troops. In large areas and broad front sectors the establishment of small convalescent camps for regiments has been successful.

Section II. MARCHES AND ORIENTATION

7. MARCHES

a. Reconnaissance

For every winter march, early and thorough reconnaissance is required. Road reconnaissance should furnish the answers to the following questions:

- (1) What is the depth and type of snow (wet, crusted, etc.)?
- (2) How is the subsol of the roadbed?
- (3) How wide is the available road? Is it rutted? What is the condition of its shoulders? Is the construction of a new traffic lane more practical?
- (4) Where are the gradients, curves, and narrow sections?
- (5) Where is there danger of avalanches and of falling rocks?
- (6) What sections are impassable owing to ice and snowdrifts? How can they be rendered passable? Estimate the manpower, materials, and time required.
- (7) Is there material in the vicinity for strewing on icy roads to prevent skidding?
- (8) What possibilities are there for detouring around obstacles and bad sections of road?
- (9) Which sections permit two-way traffic? Where can by-passes be constructed?
- (10) What is the carrying capacity of bridges (consider that they may have been weakened by drifting pack ice) and of the frozen surface of bodies of water?
- (11) Are the roads easily found at night and in fog? Are markers necessary?
- (12) Where are wind-protected resting places and facilities for shelter?
- (13) Where are the watering points?

b. Preparation for Marches

Endurance in marching may be maintained and increased by intensive preparations. The clothing and equipment of each man must be examined so that ill effects from the cold during the marches may be avoided. Shaving in the morning must be prohibited in severe cold weather. Ointments for the prevention of frostbite must be issued. March rations must be ready for consumption, wrapped in paper and carried close to the body or in the trouser pockets. Warm rations in adequate quantities must be issued before marches. Warm drinks may be taken along for distribution en route. On marches through sparsely wooded terrain, it may become necessary to take along fuel for bivouac fires.

Weapons and weapon parts which are not to be used immediately (especially rifle bolts) must be protected with covers against snow and moisture.

Winter equipment of all vehicles must be examined. Towropes for hauling vehicles which bog down, as well as planks and material to provide traction on icy roads, must be kept within easy reach. A sufficient number of assistant drivers or escorts must be assigned to vehicles proceeding singly on missions. In deep snow it is advisable to load on sleds or other vehicles single motorcycles which are not equipped with snow runners.

Calks intended to prevent horses from slipping must be examined. Spare calks and calk wrenches must be kept in readiness.

All measures for clearing roads must be initiated well in advance so that advance detachments can maintain their distance ahead of the main body. Men assigned to haul vehicles, as well as special towing details with traction

machinery or horses, must be incorporated in the march column or held in readiness at places where traction is difficult. (For instruction in making trails and clearing roads, see pars. 10 and 11.) Reconnoitered roads must be marked for the troops which are to use them (for directions, see par. 9). To regulate passing and two-way traffic, by-passes must be prepared.

c. March Discipline

Troops who are to be organized into a march column should be kept in motion during severe cold. Standing around, especially in a biting wind, must be avoided. Harassing must be done at the last possible moment. On the other hand, the time allowed for the preparation of motor vehicles must be ample. Motors must be warmed up before the march is started.

At the beginning of the march the pace must be slow. In severe cold and strong wind it is advisable to cover long distances at a slow pace, interrupted only by short rest stops. It is recommended that short distances be covered entirely without halts. Existing trails must be utilized, if need be, even relatively large formations must be marched in file or in column of twos. In deep snow, severe cold, and strong wind, the front ranks or those marching against the wind must be relieved frequently. Horsemen usually must dismount and proceed on foot.

Regulations on wearing the uniform, or special measures for protection against cold, must be revised and adapted to fit local conditions. Rifles are carried slung so that the men may warm their hands in their pockets. The most effective measure against freezing is mutual observation for first

signs of frostbite. Men riding in automobiles will be allowed approximately one brief stop every hour for the purpose of alighting and warming themselves. Drivers of open cars must be relieved frequently.

In case of interruptions, the march column must halt at wide intervals. Special pushing details from all halted vehicles must be sent forward to deal with cases of difficult traction, if hauling details have not already been assigned along the road. Special detachments equipped with vehicles must be assigned to the rear of the column to pick up exhausted men and horses, and motor vehicles that break down.

d. Halts and Rest Periods

Short halts of 5 to 10 minutes are the most effective. They afford the men necessary rest without exposing them too long to the cold. Squads must be sent ahead to reconnoiter and prepare rest areas. Their tasks are essentially the following:

- (1) Arrangement of facilities for arrival and departure.
- (2) Preparations for sheltering men, horses, vehicles, weapons, equipment, and skis.
- (3) Cleaning and warming existing shelter facilities.
- (4) Preparation of hot drinks if field kitchens are not available.
- (5) Arrangements for medical treatment areas and for repair of automobiles, skis, and other equipment.

Areas protected from the wind are the most suitable for resting places. Protection against the wind may be increased rapidly by constructing windbreaks made of branches or snow. Whether fires may be started for warming the men depends upon the situation. For extended rest periods, simple tents must be pitched or snow caves dug.

Guards must be detailed to wake up all the men, individually, at specified intervals to prevent them from freezing. (For details of tent pitching and the construction of snow houses, see sec. V, "Winter Bivouacs and Shelter," p. 57.)

Troops need warmer clothing while resting than while marching. Overcoats must be put on. Men should also drape themselves with shelter halves or blankets. During longer rest periods the changing of sweat underwear must be enforced by specific orders and must be supervised. If possible, warm rations and, above all, hot beverages must be issued. Alcoholic drinks are prohibited.

Horses must be sheltered from the wind and placed close together for warmth. They must be warmly covered, their blankets strapped to their bodies, and they should be bedded down on fir boughs for protracted rests. Precautions must be taken when the horses are watered. The water should be warmed, or hay should be placed in it to prevent the horses from drinking too fast.

The proper temperature of motors and the water in their cooling systems must be maintained by all means. If the rest is a long one, motors must be started several times to keep them warm.

8. ORIENTATION IN SNOW-COVERED TERRAIN

a. General

The appearance of a landscape is changed considerably when it is under a cover of snow. In the east the broad plains appear even more monotonous in winter than in summer. Outstanding orientation points often are completely lacking. The nature of the terrain is also changed by snow and cold. New roads frequently come into existence, while

others which are passable in summer become useless or vanish under snowdrifts. Road designations on maps are therefore not dependable reference points in snow-covered terrain. On the other hand, ridges, gorges, woods, inhabited localities, structures, and telephone lines become more prominent.

Orientation in snow-covered terrain is made more difficult by unusual climatic conditions. Extreme cold, for example, affects the accuracy of the magnetic compass. Fog and snowstorms may make visibility negligible, even over short distances, hence it is all the more important that the soldier maintain his energy and attentiveness in order to be able to exploit all means of orientation. Experience and training play a determining role. Theoretical instruction may supplement field training, but will never replace it.

The use of existing trails must be undertaken with great care because they often lead in the wrong direction. They may have been made by the enemy for purposes of deception and may lead into an ambush. Snowstorms and snowdrifts quickly obliterate trails. On skis, bearings are very easily lost at the start of a march. Therefore, in terrain where observation is difficult, and in hazy weather, only one man should start while the others observe his route.

b. Fundamentals of Orientation

A fundamental principle for determining direction and location is the knowledge of one's own position. It is important to check one's location repeatedly, even while marching. In fog or snowstorm, when the danger of losing one's direction is greatest, this may become necessary every 100 meters (328 feet). A complete picture of the vicinity should be obtained, after one's own position has been fixed,

by comparing the terrain with the map. The orientation of the map is accomplished by means of a lensatic type of compass, the stars, or conspicuous terrain features. Methods of determining cardinal directions, the time of day, and time factors for the distance to be covered are also necessary for orientation in the field.

In place of a map, a road sketch may be employed as an auxiliary means of orientation. It should contain data on cardinal directions, distances, azimuths, and special terrain features. Elevations and natural obstacles must be indicated. The drawing of road sketches and their use on marches must be thoroughly practiced.

The most important means of orientation is the lensatic compass. Every unit marching independently and every reconnaissance squad must, if possible, have several compasses of this type.

c. Methods of Orientation

The method selected for getting oriented depends on visibility. By day, of course, the most favorable conditions usually prevail. The cardinal directions may be determined by the position of the sun. It indicates due east at 0600, due south at 1200, and due west at 1800 (valid for the armies of the Eastern Front).

If the sun is not visible, an idea of the cardinal directions may be deduced from the fact that in snow-covered terrain the lee side of trees, poles, and sheds is grown over with moss and lichen. In European countries the weather side usually is toward the west, but in Russia it may also be in other directions. (Do not rely entirely on this phenomenon, but orient yourself as soon as possible by means of a compass.) In winter there generally is more snow on the

weather side. However, if the weather side does not indicate a cardinal point of the compass beyond doubt, it nevertheless is useful for reference in relationship to the direction of march. Similarly the parallel formation of snowdrifts on great plains, and of the courses of ridges and streams, is also useful. In taking bearings, note the angle which the line of march makes with the general trend of these terrain features. Then, during the march, maintain direction by keeping the features always in the same relative position.

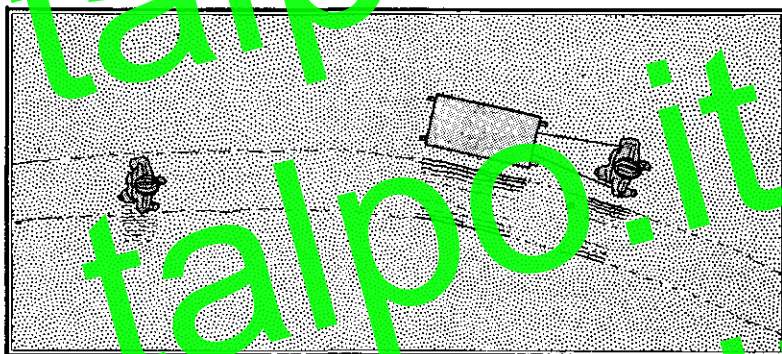


Figure 4.—Shadow-casting as an aid in following a weak trail.

Direction may also be determined by one's own shadow, but the changing position of the sun must be taken into consideration. In diffused light, shadows are weak and it is advisable to observe them closely. In such light a poorly defined snow trail will be difficult to follow but it can be made easier by casting a shadow on it constantly. One man, pulling a small sled, walks on the edge of the trail, on the side from which shadows fall. His shadow, weak though it may be, will bring out in relief the slight depres-

sion in the snow on the trail. It is necessary for another man to walk on the trail about 6 feet behind the shadow. This man will keep watching for the outline of the track and will give directions which will keep the shadow of the first man constantly on it (see fig. 4).

A cloudy sky, during periods of clear visibility, reflects the color of the terrain over considerable distances. The clouds over snow-covered ground are bright, over a pine forest or open water they are dark.

By night in clear weather cardinal and march directions are fixed by the North Star and by a knowledge of the position of the moon and such a prominent constellation as Orion.

At night, also, ground lights are perceptible over considerable distances and may be useful for orientation (automobile headlights, burning villages, muzzle flashes, flashlights, etc.).

Fog reduces visibility. Therefore, the other senses must be applied all the more intensely, especially the sense of hearing. Sound travels very far over snow-covered terrain, frozen ground, and vast lonely areas. For better hearing, it is advisable to halt frequently and listen, to wear the field cap instead of the steel helmet, and (if the temperature permits) to uncover the ears temporarily. The terrain must be studied carefully when relying on sound for orientation in order to determine whether the sound is heard directly or is an echo from the edge of a forest, slope, or wall of a house.

The sense of smell serves as an additional aid in case of fog. The wind disperses odors over large areas. Thus, for example, newly cut timber, a factory, or a stable may be identified by their characteristic odors at a considerable distance. A dog's sense of smell may be successfully used

(to stay on trails and to detect habitations and fires). A snowstorm almost completely eliminates perception by smell. The lensatic type of compass, therefore, must always be used in fogs and snowstorms. The wind sometimes furnishes assistance. When there is a steady wind, its pressure on the face can be useful in following a prescribed direction.

d. Controlling March Direction

Experience proves that where observation is difficult (for instance, in extensive wooded areas), it is necessary to employ special measures for controlling the direction of march. The leader of the unit or patrol is responsible for orientation. Under difficult conditions he may require the help of several men. One man will make checks with a lensatic compass, another will use sun and watch, and two men will count paces. If additional men are detailed for marking the route, they may be organized to form a direction squad (Finnish method) led by a special leader.

The length and time factors of the distance covered must be carefully checked. Guessing always results in errors. Exact knowledge of the length of one's own pace is necessary. At night and during snowstorms, measurements taken with a string or a length of old telephone wire are more accurate. The distance covered, the time required, azimuths, and similar data are best recorded on a road sketch, or in a march table as shown in figure 1. This procedure must be carefully practiced by patrols and raiding parties.

In case orientation is impossible as a result of an encounter with the enemy, it must be determined later by all available means. If this proves impossible because of

Route of march	Azimuth (mils)	Meters (according to map)	Actual march distance in paces ²	Actual distance in paces ²	Time of departure	Estimated march time	Estimated time of arrival	Actual time of arrival	Remarks
1. Village A to Village B.	4,800	1,540	1,540	X	0815	40 min.	0900	X	X
2. Village B to hill, 2.2 km (1.4 miles) N.	5,600	2,200	2,008	X	X	1 hr, 12 min.	X	X	X
3. Hill 2.2 km N.E. of Village B, to Village C.		1,460	1,460	X	X	42 min.	X	X	X
		5,200	4,750	X	X	2 hr, 40 min + 16 min ³	1200		
						2 hr, 56 min			

¹ Village A to Village C.

² Columns marked with "X" are to be filled in en route.

³ Ten percent must be added to the time calculated from the map.

Figure 5.—Example of a march table.

nightfall, it may, in particularly uncertain situations, be necessary to stop marching and await daybreak. If the night must be spent alongside the road, the point last marked at nightfall must be noted so that it may be located with certainty in the morning. During a heavy fog, it may be advisable to wait on a known road until it lifts rather than to proceed into unknown terrain. An effort should be made, so far as the situation and terrain permit, to maintain the straightest possible direction. After detouring around obstacles, the original direction must be resumed.

e. Conduct When Lost

When one is lost, calm and composure are necessary above all. Hasty and ill-considered searches generally lead to no result and increase the possibility of accidents and exhaustion. It is therefore best to think over the situation calmly, to retrace mentally the route already covered, and to recall occurrences during the march. Men already exhausted must be left behind under guard in a protected spot while the leader and selected men search for the right way. Anyone who is not participating in the search is not permitted to leave his place.

If the way back cannot be found, it must be decided whether a continuation of the march will serve any purpose—whether, within a reasonable distance, it will lead to identifiable terrain such as roads, railroads, or a river valley, which will further aid orientation. If, however, even such an effort proves futile, it is advisable to await a change of weather which will make orientation possible. Cover against the wind must then be sought, and steps taken to ensure security and protection against freezing.

Section III. ROADS

9. ROAD MARKING

In winter, snowfalls and snowdrifts frequently make roads unrecognizable. Therefore, careful road marking is essential. If possible, through roads must be uniformly marked prior to the first snowfall. Road designations must be known to troops who will use the routes. The removal of markers and the use of them as firewood is sabotage. Permanent routes should be designated by durable markers. In open country, poles, about 8 feet high, with direction markers, "snow men" (*Schneemänner*), wisps of straw, brushwood, cairns, and flags serve the purpose best. Snow markers may be rendered even more visible by staining them (for instance, with urine or coffee grounds, yellow is the most conspicuous color).

In areas where heavy snowfalls, fog, and other conditions make it difficult to recognize terrain features, numer-



Figure 6.—Snow-man type of road marker.

ous road markers are necessary. Orientation is facilitated if the markers are numbered in the direction of march, and if they are placed at equal distances from each other. "Snow men" have proved to be especially effective. They are constructed of small blocks of snow, 39 to 47 inches tall, with an opening at a height of about 31 inches in the direction of march. In the opening is placed a very thin pane of ice, through which refracted rays of light can be seen over relatively great distances even when visibility is poor (see fig. 6).

Road markers must be erected at least 3 feet off the trail in order to avoid damage to them by traffic. In wooded terrain, tree trunks are marked with placards or paint; branches are bent; boards, paper, or cloth remnants are fastened to trees. If complete road marking is impossible, arrow signposts must be erected at prominent points to indicate the direction of march and distance to the objective. For shorter distances, direction arrows will be sufficient.

Road markers which have been in use for long periods must be watched, because the enemy may move them. If routes are changed, the distances indicated on the markers must be revised.

Simple marks in the snow (for instance, three impressions made close to each other with the ring of a ski pole), snow men, and similar signs are adequate for the marking of temporary roads, such as those used by patrols. If strange trails cross the route, they must be obliterated within the immediate vicinity of our own tracks so that the troops will not go astray. It is frequently advisable to leave guards at such points in order to keep units on the proper route.

10. ROAD MAKING

a. General

The construction of roads in winter is not the special task of the engineers but is the duty of all troops and arms of the service. In snowy terrain it is frequently easier to construct new roads at favorable locations (for instance, to by-pass defiles) and to maintain them than to clear existing roads. It may well be necessary to construct new cross-country roads frequently (for evacuating marches, bringing heavy weapons into position, etc.). Roads in snow-covered, pathless terrain are cut by small trail details which speed ahead on skis to mark the route and by larger road-construction detachments on foot. In winter warfare the formation, equipment, and training of trail details and road-construction detachments are indispensable in all units.

In establishing routes for tactical and technical purposes the following types of terrain and approaches are most suitable: flat country, plateaus, sparsely wooded land, forest paths protected from the wind, frozen rivers, lakes, swamps, and existing field paths. Across open country, trails should be laid preferably along telegraph lines, fences, and similar installations. Terrain which is exposed to snowdrifts is less suitable. Therefore, routes should be established from 100 to 150 meters (328 to 492 feet) from the edges of woods, and in clearings at the narrowest points. Heavily wooded terrain is difficult and should be by-passed whenever possible. This also applies to insufficiently frozen swamps, patches of melting ice, snow-filled hollows, deep ravines, gorges, defiles, and steep slopes.

Obstacles around which snowdrifts may form (for instance, farm buildings, piles of stones, and brushwood)

must be removed or by-passed at a distance equal to 10 times their height. On inclines steeper than 10 percent it is necessary to cut the trail in serpentine fashion, oblique to the slope. Curves must be made as wide as possible, because sharp curves are more difficult for sleds than for wheeled vehicles.

When trails are being reconnoitered and plotted, the question whether the roadway is to be a one-lane or a two-lane artery must be considered. At first only a one-lane section is constructed. (The standard width of sleds is approximately 2 feet 10 inches.) If passes wide enough for two sleds are later added, they should be at least 15 meters (about 49 feet) long. Finally the road may be enlarged to make a two-lane artery. A double lane is preferable to two separate lanes because the latter are less efficient in case of traffic jams and snowdrifts.

b. Methods

The method of making roads depends upon the type of traffic the roads will have to bear, upon the depth of the snow, and the equipment available. Ski trails cut by a trail detail will suffice for small ski detachments which use only man-hauled sleds. Larger units with animal-drawn sleds and wheeled vehicles will require a road-construction detachment. Trail details must start about 1 hour ahead of a marching column. Road-construction detachments need a start of several hours, depending upon the length of the road to be cut.

A trail detail usually is composed of one noncommissioned officer and 6 to 12 men on skis. Several trail details form a trail troop. It is advisable to attach rulers to ski poles for measuring the depth of snow. The trail detail

lays several ski trails to facilitate the movement of the following unit. If possible, it removes minor obstacles and erects simple road markers. In case the unit uses man-hauled sleds, two men of the trail detail ski behind each other in such a manner that the rear man uses only one ski track of the front man in order to cut a third track, thus making a trail for the sleds (see fig. 7).

Light sleds loaded only with shovels and picks travel at the head of the column. They are followed by others which drag coniferous trees or logs. Next in the column come



Figure 7.—Functions of the trail detail: ((1) The leading pair cuts the first track; (2) the second pair clears the curves; (3) the squad leader maintains the direction of march; (4) this pair removes obstacles; (5) these men cut a third track (triple ski trail) for light sleds; (6) this pair levels the trail; (7) these men post road signs and improve the sled trail.)

<i>Designation</i>	<i>Strength</i>	<i>Mission</i>	<i>Equipment</i>
Trail-blazing detail on skis	1 O, 6 EM	Under command of an experienced officer, the detail plots the trail, straightens curves and grades rough spots, removes small obstacles such as branches, and marks the route.	Compass, wire-cutters, ice-drill, crowbar, ice measuring stick, 2 axes, marking equipment, skis.
Trail-blazing group with point man	2 NCO's, 18 EM	Pushes down snow on trail, removes obstacles and puts away obstructing brush, wood and trees, strengthens weak portions of trail, renews trail-blazing detail.	1 or 2 MG's and portable entrenching tools. Other equipment is loaded on sleds.
Lightly loaded sled	2 EM, 2 horses	Cuts the first sled track.	4 shovels, 2 axes, 4 pick-axes, 1 crowbar, saw, demolitions material, ice-drill, instruments for measuring ice capacity.
Heavily loaded sled	2 or 3 EM, 2 horses	Deepens and solidifies the sled track.	6 shovels, 8 axes, 6 pick-axes, 3 crowbars, 3 saws, 1 pair of wire-cutters, 4 Finnish hoes, 1 hammer, 1 pair of pliers, demolitions material, construction material, wire.
Sled with tree trunks	1 NCO, 1 EM, 2 horses	Clears snow from foot and vehicular trails.	1 axe, 1 pickaxe, 1 snow shovel, 5 tree hooks or chains.
Sled with fir tree	2 EM, 2 horses	Clears snow from foot and vehicular trails.	1 axe, 1 pickaxe, 1 snow shovel, 5 tree hooks or chains.

Figure 8.—Organization and disposition of a road-making detachment.

animal-drawn sleds to cut a roadway and pack it down. Supply sleds and wheeled vehicles form the rear. The effect of this sequence of sleds with varying loads is to produce a road for the main body of the unit. (For details, see fig. 8.) The men in the march column pack the snow solid and remove obstacles. If the snow is deep, skiers are sent ahead of foot troops. Men and draught animals at the head of the column must be relieved frequently.

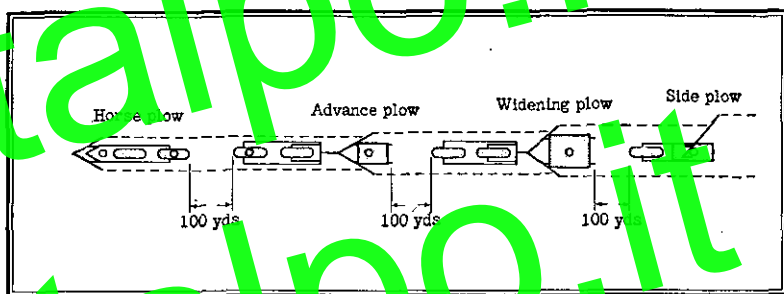


Figure 9.—Sequence of snow plows for clearing roads.

Since newly cut roads are soon damaged at many points by large bodies of marching men, it is advisable to assign a road-construction detachment to the head of each column for the purpose of making repairs. The detachment is generally composed of a reinforced platoon under the command of a commissioned officer.

Snow about 20 inches deep can be cleared with snow plows. For this purpose the following types are used in sequence: horse plows, advance plows, widening plows, and side plows (fig. 9). The horse plow is not drawn but is pushed by horses. A strong detachment of men must always be allotted to each plow section. They must be

equipped with shovels, axes, and pickaxes for the removal of obstacles. An improvised snow plow is shown in figure 10.

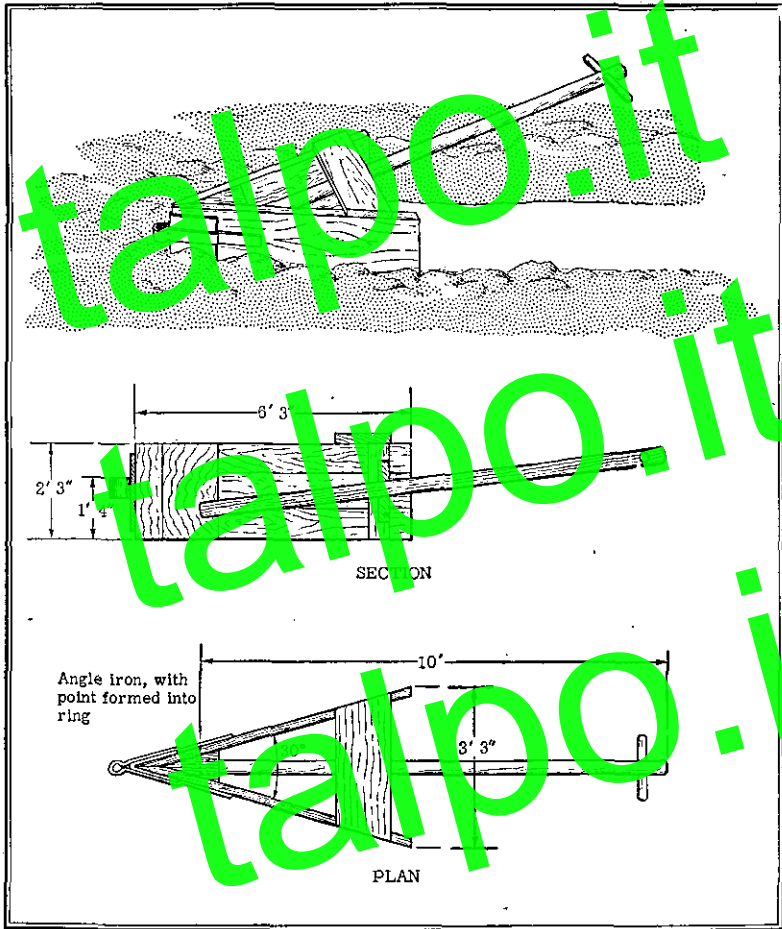


Figure 10.—Improvised snow plow.

Roads with 20 inches or more of snow which will be used by heavy traffic can be packed solid with snow-rollers. The rollers are preferable to snow plows because they do not create earth banks at the roadside. (Rollers are not included in tables of basic allowances. It is desirable to have them made by construction troops for issuance to combat troops. A suggested improvised type is shown in fig. 11.)

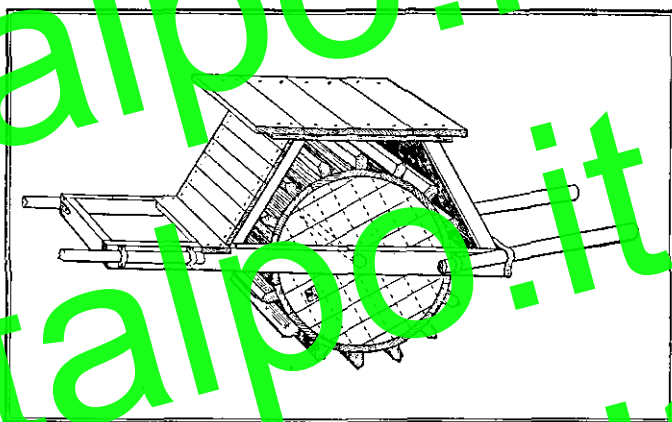


Figure 11.—Improvised snow roller.

Another method of hardening roads is to freeze them. This method was very successful in Finland and northern Russia and depends upon the availability of water. Only sleds with wooden water tanks are required. The tanks must have several openings on the bottom, at the rear, for spraying the water. To prevent the freezing of the water while it is being transported, the tanks must be heated with hot stones or by other means.

11. WINTER ROAD SERVICE

a. General

Continuous and safe travel on all thoroughfares of military importance must be assured in the winter as well as in other seasons.

Various types of vehicles can negotiate, on level ground, the depths of snow listed below:

Horse-drawn vehicles	12 inches.
Commercial-type passenger cars	8 inches.
Commercial-type trucks	12 inches.
Cross-country-type passenger cars with chains	14 inches.
Cross-country-type trucks with chains	16 inches.
Prime movers and tanks (for instance, an 8-ton prime mover with a trailed gun)	22 inches.

Icy roads, especially on grades, can hardly be used without special maintenance. Roads must be cleared after every snowfall, and icy surfaces must be sanded. This procedure requires special road service in winter, and such service is the duty of an troops. Natives with horse teams, prisoners of war, and, especially, municipal road services, will be used as auxiliary forces as much as possible. (For this reason it is often advisable, in regions with many settlements like the Ukraine, to use roads which lead through the villages.) Regulating and supervising traffic is an essential part of the winter road service, which should be linked with the existing communication net. In case of a block system of traffic, communications must be installed between block points. Every individual using the road, especially the drivers of motor vehicles, must, for the common good, adhere to strict road discipline, observe all traffic signs, obey all orders which may be issued, and help in a comradely manner in case of traffic jams and accidents.

b. Preparations

With the beginning of cold weather, a winter road service must be started on all important roads and paths. Posts for road guards must be established along the road, and communication between the posts and headquarters must be provided.

The road guards reconnoiter certain sections of the road before the first snowfall, and after the beginning of freezing weather and snow they travel over these sections and check their condition. They report immediately the depth of snowfalls, snowdrifts, and icy surfaces.

A simplified system for reporting road conditions, which was used successfully by an army group in the east during the winter of 1941-42, is given below:

(1) *Weather conditions on the road.*—

Free of snow and ice	0
Muddy	1
Slush of snow or ice	2
Slippery	3
Hard snow crust	4
Soft during the day, frozen at night	5
In the process of drying	6
Dry	7
Snowdrifts	8

(2) *State of repair.*—

No repairs in progress at the moment	0
Work in progress on road	1
Single-lane road	2
Single-lane road with by-passes	3
Double-lane road	4

(3) *Capacity of roads.*—

For vehicles of all kinds	0
For trucks up to 3-ton capacity	1

For trucks up to 1½-ton capacity and for tanks.....	2
For tanks and animal-drawn vehicles only.....	3
For one-horse sleds only	4
For pack animals only	5
Closed to all vehicles and for all purposes.....	6

For example, if in a reconnaissance report the condition of the thoroughfare was reported as 433, it would be interpreted as follows: the street is covered with a hard snow crust, has a single lane with by-passes, and is suitable for tanks and animal-drawn vehicles.

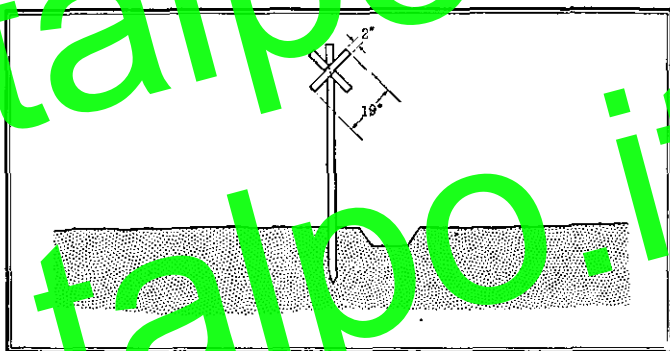


Figure 12.—St. Andrew's cross used to mark by-passes.

All personnel and auxiliary forces available in billets along the road, including reliefs and reserves, must be equipped and organized with foresight. Proper equipment must be furnished them. The equipment should consist of weatherproof clothing, good footgear, mittens, knitted wool caps, snow goggles, wide shovels, spades, pickaxes, and picks. The road must be cleared of everything that might impede traffic.

Shortly before the first frost sets in, the surface of soft roads is made even by the use of graders, agricultural

equipment, and heavy harrows. Later snow-clearing work is considerably facilitated by these measures.

Markers are placed at the edge of the road, on both sides if possible. They are attached to milestones, to trees, and to fence rails at points where material for road construction is stocked, and are also put up at passages and obstacles of all kinds. By-passes are especially marked by St. Andrew's crosses (*schräge Kreuze*) (see fig. 12). Snow fences and antiskid material are stored alongside the road.

c. Clearing Roads.

Troops will use all available equipment—shovels, rollers, and horse-drawn, motorized, and centrifugal blows—for clearing roads. (Motor-equipped snow-clearing troops are usually army troops.) After a heavy snowfall, a mass employment of manpower is always required. Clearing must be started immediately after the first snowfalls and must be repeated continually. Weather makes the work more difficult.

If possible, the road must be cleared down to its surface. If some snow is to be left for sled traffic, only a depth of 1 to 4 inches is needed. It is desirable, for the protection of road surfaces, to retain a firm snow cover on the central and northern fronts until the end of freezing weather.

Snow cleared from roads must be widely scattered away from road ditches. It must not be piled up as piling would cause new snowdrifts (heavy work done once is worthwhile). Deep-rutted snow which has been hardened by traffic or freezing and has an uneven surface can be leveled with agricultural plows and heavy harrows. Loose snow is packed into the ruts. Melting snow must be drained far off to the side, and mud must be removed. All traffic signs, especially

warnings at railroad crossings, must be shoveled clear and checked continuously.

d. Snow Fences

Snow fences of two types have proved effective in preventing snowdrifts on roads. When an "accumulation fence" (*Ablagerungszaun*) is used, snow piles up on either side of it. "Guide fences" (*Leitzaune*) cause the snow to be swept by the wind at an oblique angle to the road and deposited at a distance from the thoroughfare where it will not interfere with traffic (see fig. 13).

Snow-fence protection where the prevailing wind blows approximately parallel to the axis of the road is shown in figure 13 (7) and (8). All fences must be set at an angle of 25 to 30 degrees to the axis of the prevailing wind, and they must be erected 65 to 80 feet from the edges of the road. Additional fences must be erected 100 to 150 feet from the edges.

Snow fences are made of poles and set in sections 3 to 7 feet square. Rigid or flexible sections may be made and erected (fig. 14). They must be prepared in advance and erected before the first snowfall (often even before the frosts begin). Fences must be used where the natural contours of the terrain may cause snowdrifts. They should be erected at a distance from the edge of the road which is 10 to 20 times the height of the fence. They must be vertical and, if possible, at right angles to the prevailing direction of wind. Natives must be asked for information on wind conditions and drift spots. If wood is lacking, timber fences may be replaced by snow walls made of snow blocks. These require constant repair, but they have proved their usefulness in sparsely wooded regions, such as the Ukraine.

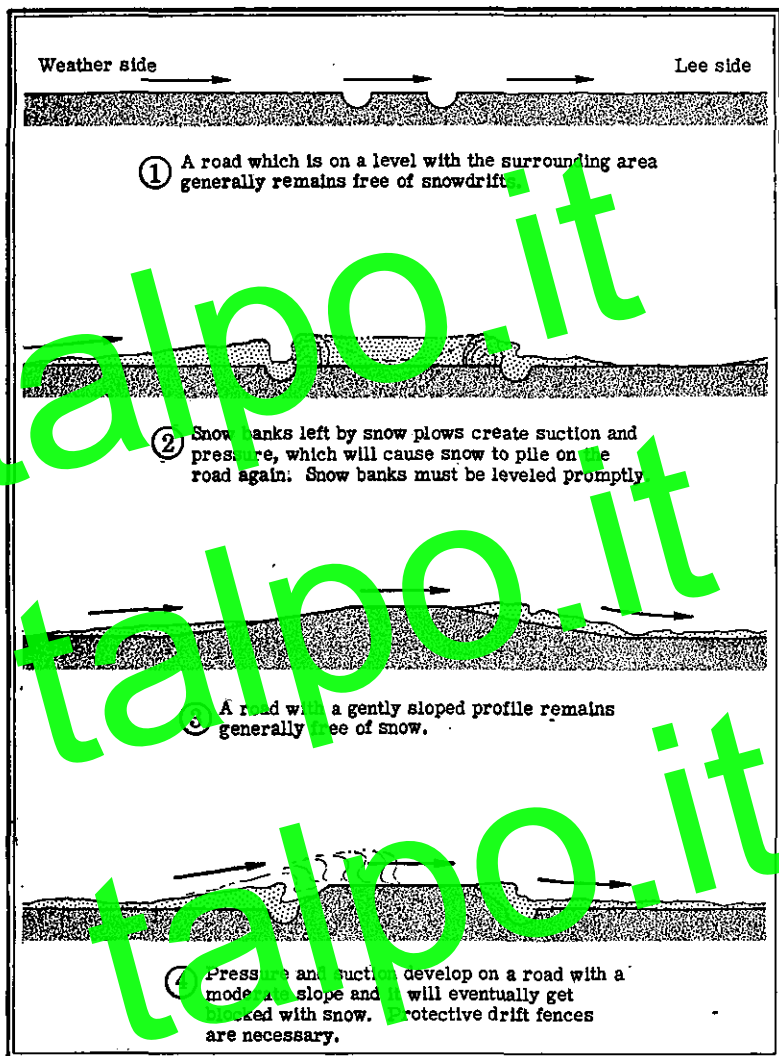


Figure 13.—Snowdrift factors affecting roads.

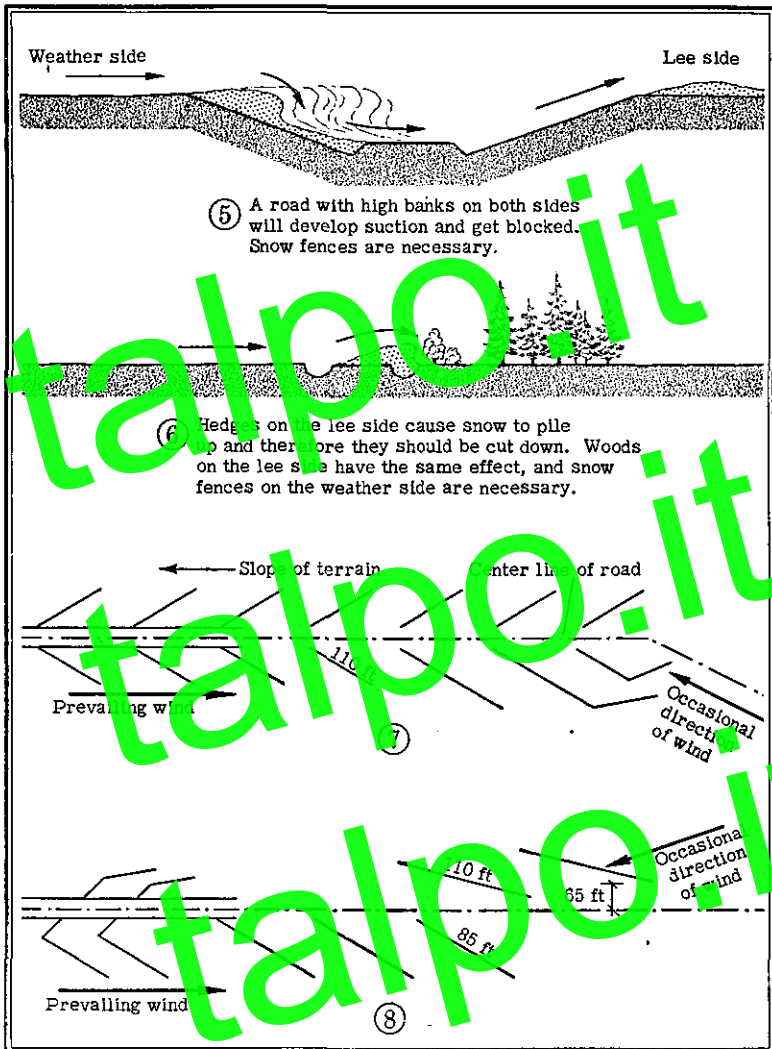


Figure 13 (continued).—Snowdrift factors affecting roads.

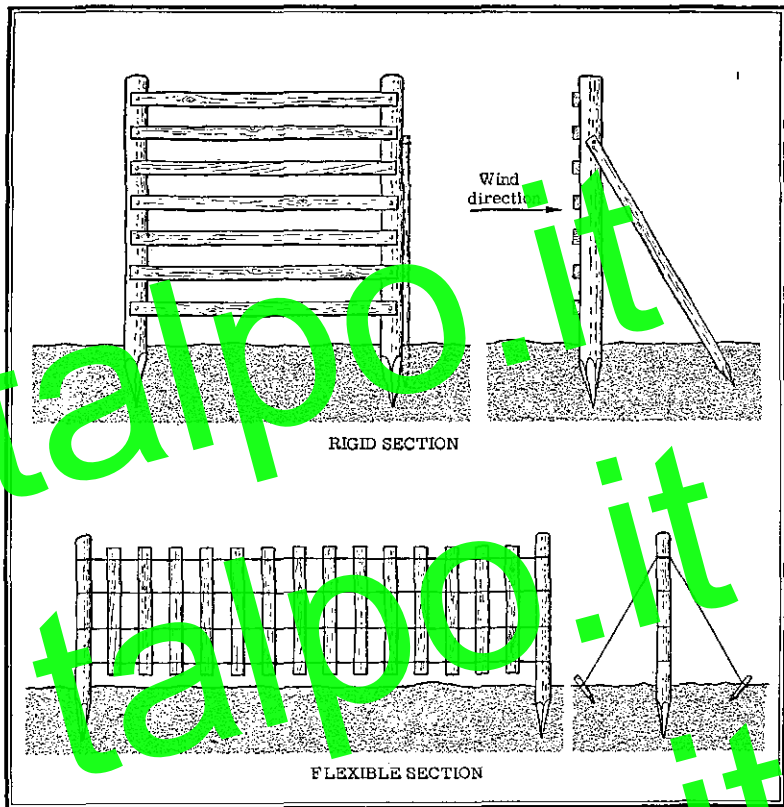


Figure 14—Types of snow fences.

e. Treatment of Slippery Surfaces

Slippery snow and ice surfaces should be sprinkled with small-grained sand, gravel, or crushed rock. For slippery snow surfaces, a coarser type of antiskid material can be used than for ice because it is pressed into the snow. The antiskid material must be piled in advance along the road-

side. It should contain no earth. The piles must be marked so that they may be found after they are covered with snow. The material is spread immediately after the surface becomes slippery. If sprinkling is done from trucks, the shovelers must be tied to the trucks with ropes. When the ice crust is chopped or removed, the surface of the road must not be damaged.

f. Transition from Snow to Mud

When, during the transition period from winter to spring, temperatures are above freezing in daytime and below at night, roads are dry and hard only at night and in the morning. Vehicular traffic, therefore, must be limited to these hours. Men whose duty it is to dispatch vehicles must see to it that advantage is taken of the most favorable hours. All drivers, and especially drivers of motor vehicles, must strictly observe traffic discipline.

Besides the measures mentioned under the heading "Seasons of Mud and Thaw" (par. 3, p. 3), the following points are important in maintaining roads:

(1) Water must be drained off the roads. Roads, therefore, must be cleared of snow before the thaw period so that ditches and culverts can function properly.

(2) Driving on dirt roads must be absolutely avoided unless such roads are completely dry. Cart traffic during the mud period must be directed to tracks on the left and right of the road.

(3) The drying of dirt roads can be expedited by grading the surfaces with emergency leveling mows. The mud that is removed must not interfere with drainage. Ditches and culverts must be kept open.

(4) In inhabited localities, roads can be graveled by the demolition of stone buildings. Large stones make the road worse; only an even layer, improvised from bricks, will serve the purpose. Sticks and planks for the construction of corduroy roads must be prepared during the frost period in the combat zone and on all indispensable supply roads. This applies

especially to those sections of road which lead through depressions or valleys and thus dry later than roads on high ground.

(5) Sources of sand should be located. The sand should be piled in readiness wherever it may be needed for spreading on wet sections of roads.

(6) Lumber for the construction of small bridges should be available at the lowest points of roads and paths.

12. ICE CROSSINGS

a. Capacity of Ice

The thickness of ice crusts may vary in every body of water. Over river currents, near the banks, and under snow, the ice crust is generally thin. This also applies to swampy ground and warm springs. An ice crust under which the water level has fallen breaks more easily than one resting on the surface of the water. Large blocks of ice

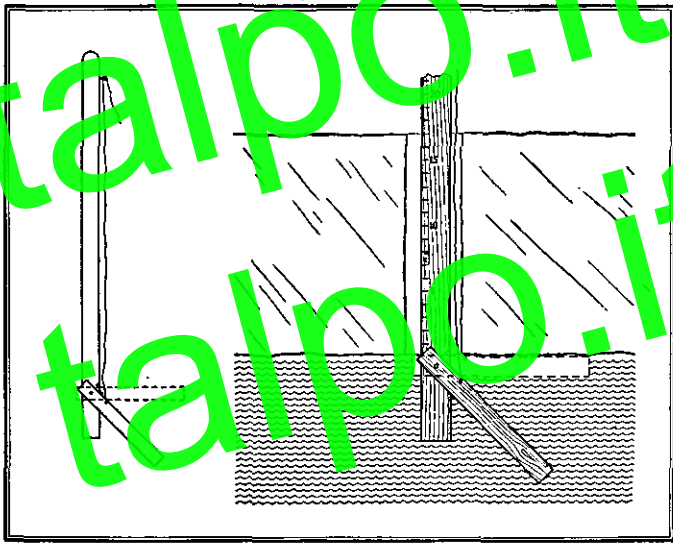


Figure 15.—Ice-measuring stick.

can serve as a raft for several persons. Caution! During the thaw period ice becomes dull and brittle, and loses its carrying capacity, and heavy traffic wears through very quickly. In determining the carrying capacity of ice crusts, not only the thickness but also the nature of the ice is a factor. Only light, clear ice is a reliable carrier. The familiar dull upper and lower layers must not be considered in estimating its strength. Before venturing on large-scale ice crossings, sample blocks must be cut out and checked for firmness. Measurements are taken with a centimeter rule equipped with a movable angle arm (see the "ice stick," fig. 15).

The load capacity of ice is shown in figure 16. These factors are dependable only when the proper march intervals are observed, and they give only a general idea of the weight which can be sustained by ice surfaces.

b. Preparations and Safety Measures

A crossing must be made on an ice crust of uniform thickness and, if possible, one without holes. Approach and departure roads and some by-passes must also be available.

For measuring the thickness of the ice along the crossing, holes are cut at distances of about 10 to 15 feet from the center of the route, and spaced from 35 to 60 feet apart. The crossing and a strip about 20 feet wide on both sides of it are cleared of snow so that the condition of the ice may be watched during the march. Crossings for motor vehicles and foot troops are sprinkled with sand. For sleds, a thin layer of snow should be spread on the ice. The various crossings, roads of approach and departure, and holes will be marked by small snow walls, railings, or poles. The

carrying capacity of the ice and the intervals to be maintained will be clearly shown on posters.

<i>Ice thickness (inches)¹</i>	<i>Type of march column</i>	<i>Minimum interval (feet)¹</i>
1.5	Single riflemen on skis	16
1.9	Infantry in extended order	16
2.7	Infantry in file with double intervals	23
3.0	Infantry in march column; single horses; sleds without loads; motorcycles.	33
5.0	March column of infantry and cavalry; single sleds with up to 2,000-kg (4,410-lb) loads; gun and limber of light gun-howitzer, separated	49
7.8	Light artillery (up to and including light gun-howitzer, horse-drawn), medium passenger cars, 1½-ton trucks with a total load of 3½ tons.	65
9.8	2-ton trucks with a total load of 4 tons.	82
11.8	Close column of all arms; 3-ton trucks with a total load of 6 tons.	98
15.7	7-ton trucks with a total load of 13 tons; 10-ton trucks with two rear axles; armored scout cars; Mk II tanks.	115
15.7	20-ton vehicles; Mk III and IV tanks	131
23.6	45-ton vehicles	164

¹The explanation for the odd figures is that they were converted from centimeters and meters to feet.

Figure 16—Load capacity of ice surfaces.

Surveillance for cracks must be maintained by bridge guards. Cracks can be frozen solid by filling them with

snow or water. Single cracks oblique to the crossing do not essentially decrease the carrying capacity of the ice, but large parallel cracks are indications of exhausted carrying capacity, and when they occur, a new crossing must be sought.

Traffic across ice, like traffic across a bridge, must be strictly controlled. Traffic guards must be stationed on both banks and on the ice. Rescue services and salvage parties must be kept on the alert near the crossing to act

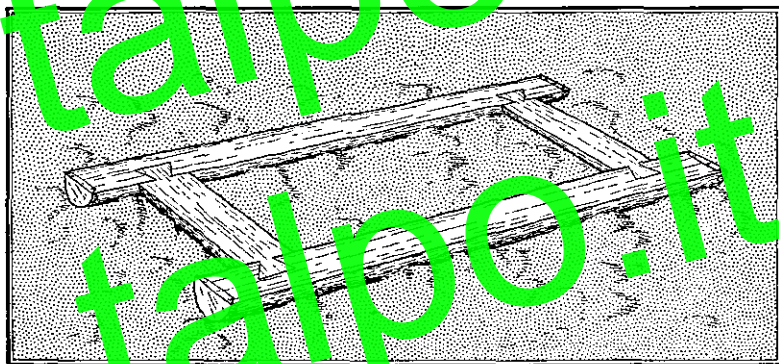


Figure 17.—Ice-crossing frame for guns and heavy vehicles.

in case of accidents. They must have proper equipment, such as planks, trees, ropes, tripods, and block-and-pulley arrangements.

c. Crossing

The crossing must proceed continuously. Do not halt on the ice! Mounted personnel and drivers of horse-drawn vehicles will dismount and lead the horses (screw in the

calks). Motor vehicles and tanks must drive slowly. They are not allowed to turn or to pass other vehicles while on the ice.

The assistant drivers of heavy vehicles must observe carefully the vehicles ahead of them. For the crossing, guns and heavy wheeled vehicles can be mounted on sled-like wooden frames; this procedure will make traction easier, distribute the weight, and prevent the wheels from cutting into the ice (see fig. 17).

4. Reinforcement of Ice Surfaces and Ice-Bridge Construction

Weak crusts which are to be used for the crossing of troops may be reinforced by freezing. The simplest method of ice reinforcement is to put layers of snow and small lumps of ice (about 1 inch square) on the surface and pour



Figure 18.—Ice reinforced with layers of twigs and straw.

water on to freeze them. Three of these layers, each frozen separately before the next is added, increase the carrying capacity by about one-fifth.

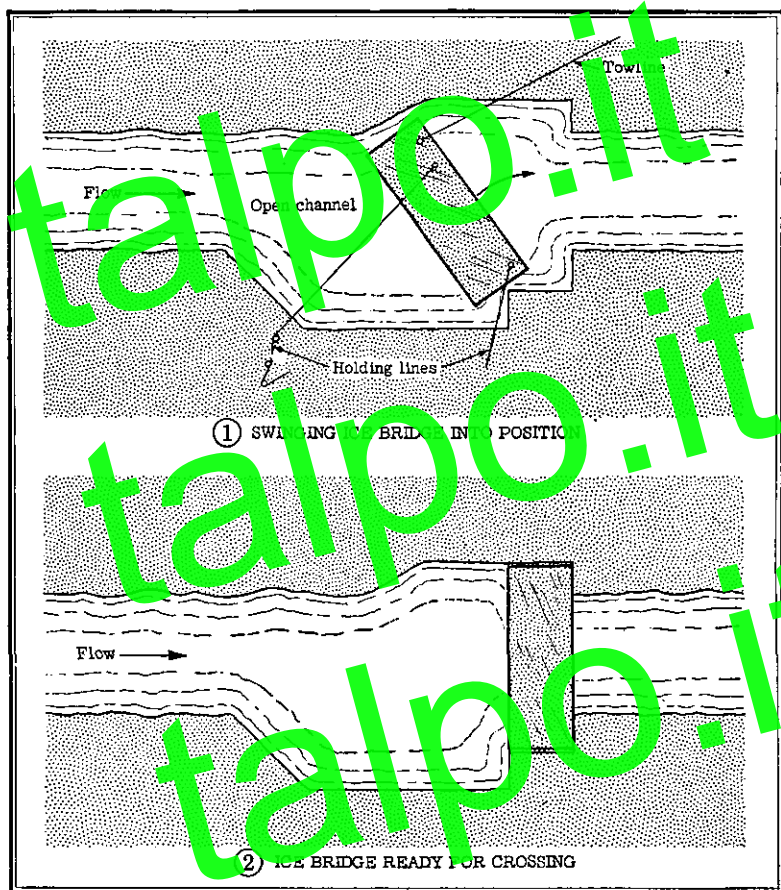


Figure 19.—Ice bridge for crossing open channels in partially frozen bodies of water.

The carrying capacity of the ice crust is increased by about one-fourth by adding and freezing to it several layers of twigs or straw, each 2 to 4 inches thick (fig. 18). Likewise boards, planks, or round lumber can considerably reinforce the crust if they are added and frozen in a similar manner. (Be careful: sunshine causes the ice to melt.)

It is also possible to traverse open sections of partially frozen bodies by means of an ice bridge if the water is still or flows slowly. For this purpose, a long block of ice is sawed out near the bank and swung across the opening (fig. 19). This method proved very effective in Finland.

Frozen swamps can be crossed easily, though the thickness of the snow and ice must be checked prior to the crossing. Most swamps freeze rapidly and the ice remains as a solid crust on top. Mossy swamps (tundras) freeze slowly and the ice bursts open quickly when the thaw begins. Mossy swamps covered with brushwood are easiest to cross. Swamps covered with the first growth of willows and elder trees do not freeze adequately.

Section IV. RAILROAD MOVEMENTS

13. GENERAL

The passenger cars which are available are not adequate for the movement of troops. Therefore, freight cars are being used as troop carriers even in winter, and it must be realized that not all freight cars are equipped with stoves. Even in passenger cars heating cannot always be expected, because of technical difficulties. This is especially true of foreign cars, railroads which are electrically operated, and small troop trains which are attached to freight trains. Consequently, before the start of any movement, troops must take all possible measures to protect themselves and their own equipment against extreme cold; the transportation authorities may be consulted for advice.

14. PREPARATIONS FOR A TRAIN MOVEMENT

The movement of groups larger than 30 men should be planned at least 2 days in advance so that the most suitable cars may be prepared and the heating installations checked. For the comfort of troops or horses, the floors of freight cars should be abundantly covered with straw. Walls which are not air-tight should be sealed with paper and straw. If possible, additional blankets should be issued.

Wooden compartments should be constructed as protection against the weather for anti-aircraft crews, and also for field-kitchen crews if the field kitchens have not been placed in freight cars constructed for this purpose. If compartments are made, however, care must be taken that the cars are neither damaged nor overloaded. Planks should

not project. The antiaircraft crews, as well as the field kitchen crews, should be equipped with antifrostbite salve (*Frostschuttsalbe*), protective goggles, guard-duty surcoats, and overboots.

In snow or in slippery weather motor vehicles and tanks should be loaded and unloaded only if railroad cars, portable loading platforms, and loading bridges have been cleared of snow, and sand has been strewn on the floor. Motor vehicles and tanks should be wedged in especially tight and lashed down with cables in order to prevent them from sliding. Storage batteries should be removed from vehicles and transported in heated passenger cars. In extreme cold the radiators of motor vehicles should be covered to prevent freezing. If necessary, pack them completely in straw, straw mats, or blankets. Water containing only a small amount of antifreeze solution should be drained out of radiators and kept in receptacles, if they are available. When chemical stoves are used as protection against the cold on trains which are transporting tanks, the stoves should be refilled at the scheduled fuel stops.

In slippery weather, horses should be loaded and unloaded only when portable loading platforms and loading bridges have been strewn with sand. Horses must be well covered.

All measures should be taken to insure adherence to the time limit fixed for loading. For this purpose, prompt contact with the loading stations is important. If the time limit for loading and unloading is not observed, there might be serious disruption of the train schedule.

15. PROTECTIVE MEASURES EN ROUTE

The passenger cars should be arranged behind the locomotive in such a way that the heating of all cars will be as-

sured. German freight cars are, with a few exceptions, equipped with stoves which are the property of the railroads. These are installed by the railroad authorities, who also provide each car with a supply of fuel. In order to obtain new supplies of fuel, the transport officer must communicate with the railroad station provost or the station master.

In an emergency, fuel may be taken from the fuel supply for the engine. In the Russian broad-gauge freight cars issue stoves should be installed, but the stove must not be permitted to come in contact with the wood. The smoke should have a free outlet. Fire extinguishers must always be in readiness. The use of car furniture, snow fences, or equipment from railroad stations as fuel would be very much to the disadvantage of the units which follow and must absolutely be avoided. This also applies to the stealing of heating hoses, stove pipes, coal boxes, sitting and sleeping facilities, and door panels. Heating installations should be handled with great care. The misappropriation of stoves upon detrainng is forbidden. The railroad authorities are responsible for the illumination of the cars, but the failure of lighting facilities in Russia must be reckoned with. Emergency illumination with the unit's own materials should therefore be prepared. Lights should always be covered.

If units are transported without their own field kitchens, a request for supplementary rations must be made at the same time that the movement is arranged. During the trip continuous contact with the transportation authorities must be maintained. A request for warm drinks from the food distributing points of the German Red Cross should be made in advance through the transportation authorities.

If a movement is made in unheated cars, the troops should be permitted to stay in heated waiting rooms during comparatively long train stops. For this purpose, contact with the transportation authorities should be established and maintained en route in order that arrangements may be made.

At every stop the field kitchen should dispense hot drinks. Frequent relief of the anti-aircraft crews and train guards should be arranged. At fuel stops, troops in heated cars will regularly change places with those in unheated cars (never while the train is in motion).

During long stops, the men should detrain and engage in calisthenics, but they may detrain or entrain only upon command. Guards should be posted to prevent soldiers from crossing the rails. Doors and windows should not be left open unnecessarily; otherwise, the train will become cold. A guard should be posted at each stove, especially during the night.

Section V. WINTER BIVOUACS AND SHELTER

16. BIVOUACS

a. General

Combat requirements and the dearth of settlements, which often are useless anyway for the quartering of troops, frequently make it necessary to be completely independent of permanent billets. On the other hand, frequent bivouacking may impair the combat efficiency of the unit.

Especially careful security measures are required when in bivouac. The site of a bivouac should be camouflaged as much as possible, and should be difficult to approach by the enemy. Nearness to protecting sectors is therefore generally advisable. In addition to aggressive reconnaissance and security measures, the construction of field fortifications (and above all of obstacles) guarantees the safety and un molested quartering of the unit. Small units, especially patrols, can best provide security for themselves in terrain which cannot be reconnoitered easily.

Sentries must be well camouflaged to avoid revealing the bivouac. Low temperatures or biting wind will make it necessary to relieve them frequently, but care must be taken to maintain continuity of observation and to prevent the enemy from drawing definite conclusions concerning the posting of security forces. Weapons and skis must be kept within easy reach.

Aside from tactical requirements, the selection of the bivouac site must depend on protection against dampness,

wind, and cold; and nearness to a supply of wood and lumber is desirable. Low ground, depressions, and valleys usually have lower temperatures than their surroundings. Snowdrifts around hollows and accumulations on the lee side of elevations may be used in the construction of snow caves. Areas free of snow are exposed to the wind and are not suitable for bivouacs. Wooded areas are warmer than open fields and conceal the glow of fires. Fir trees which are not too high with branches that extend down to the snow afford good shelter possibilities for smaller units which are heavily snowed in.

Work on the bivouac must begin immediately after the halt so that the men may stay warm. Extra time spent on construction shortens the time available for rest but ensures greater relaxation and warmth later.

Beds of foliage, moss, straw, boards, skis, furs, and shelter halves may be used as protection against dampness and low ground temperatures. Clothing and equipment must be cleaned of snow before they are brought into the bivouac. It may be necessary to have this measure enforced by sentries. Since wind diminishes warmth and affects the heating of the shelter, the entrance must be placed on the side that is least exposed to the wind. It should, if possible, be close to the ground and is best if it leads upwards. The shelter itself should be as low as possible, while bedding facilities should be as high as possible. The sources of heat must be placed low in fire holes and cooking pits. Special protective walls and plastering with earth and snow minimize the effect of wind.

The types of bivouac construction depend upon the situation and upon the material and equipment which is available. Experience teaches that even bivouac conditions

which in the past have been considered unsuitable, or practical only in an emergency, are completely suitable for German soldiers.

After adequate training and experience, living in winter bivouac is not injurious to health, even in very cold weather. Preliminary acclimatization is necessary. Extra underwear and an under jacket should be worn as protection against the cold. Blankets warm the body better than overcoats. If the underwear is wet and there is no chance to dry it, it must be worn over the dry extra underwear and the under jacket. Otherwise, if the wet underwear is taken off, it freezes stiff. The changing of underwear must be enforced. Several light layers of clothing keep a man warmer than one thick garment. All tight-fitting articles of clothing must be loosened. Rags and newspapers pushed in several layers into the trousers and under the jacket (especially near the chest, abdomen, and kidneys) are good protection. Ear muffs, knitted wool caps, mufflers, wristlets, and gloves complete the bivouac uniform. Shoes must be put on again after socks are changed in extremely cold weather in order to prevent the leather from freezing stiff. During the night the haversack may be used as a footsack to warm the feet.

Prior to sleeping in a cold bivouac, the body must be warmed by vigorous movements such as calisthenics and long-distance running. If several men sleep alongside one another, it is advisable that they do not wear too many garments, but use some of their garments as ground sheets and some as blankets. If possible, the bivouac must be heated. It is especially important to heat a tent bivouac. If tents are pitched on bare frozen ground, it is advisable to warm the ground beforehand by means of well-distributed fires. (For further measures pertaining to life in winter

bivouac, see sec. IX, "Protection against Cold, Snow, and Thaw," p. 127.)

b. Snow Shelters

The basic types of shelters are snow huts, canvas tents, branch tents, and earth huts. Practice in the construction of the shelters described below is indispensable for winter warfare in Russia, and a prerequisite to conquer the great aversion to snow as such. Only thorough training and adaptation will help.

Snow is windproof and retains warmth (three times the warmth retained by wood). It is merely necessary to place a layer of some insulating material between the body and the snow to keep the snow from melting. This layer may be bedding made with thick underwear, the uniform, camouflage dress, the overcoat, a shelter hat, or a blanket.

Where the situation permitted and the depth and consistency of the snow was suitable, types of snow shelters that proved effective were the snow hole, the snow cave, the snow pit, the snow house, and the Eskimo-type igloo.

17. SNOW HOLE

The snow hole is an emergency shelter for protection against freezing in a snowstorm, or in case an attack is stopped in open snow-covered terrain. It is simple and can be made rapidly. Spades, skis, and bayonets may be used for digging it. Even when no tools are available, the soldier can lie on his back on top of snow 20 inches deep and create a hole in a few minutes (fig. 20). He pushes with his feet, digs with his hands, and repeatedly turns over, thereby fashioning a hole the length of his body and the

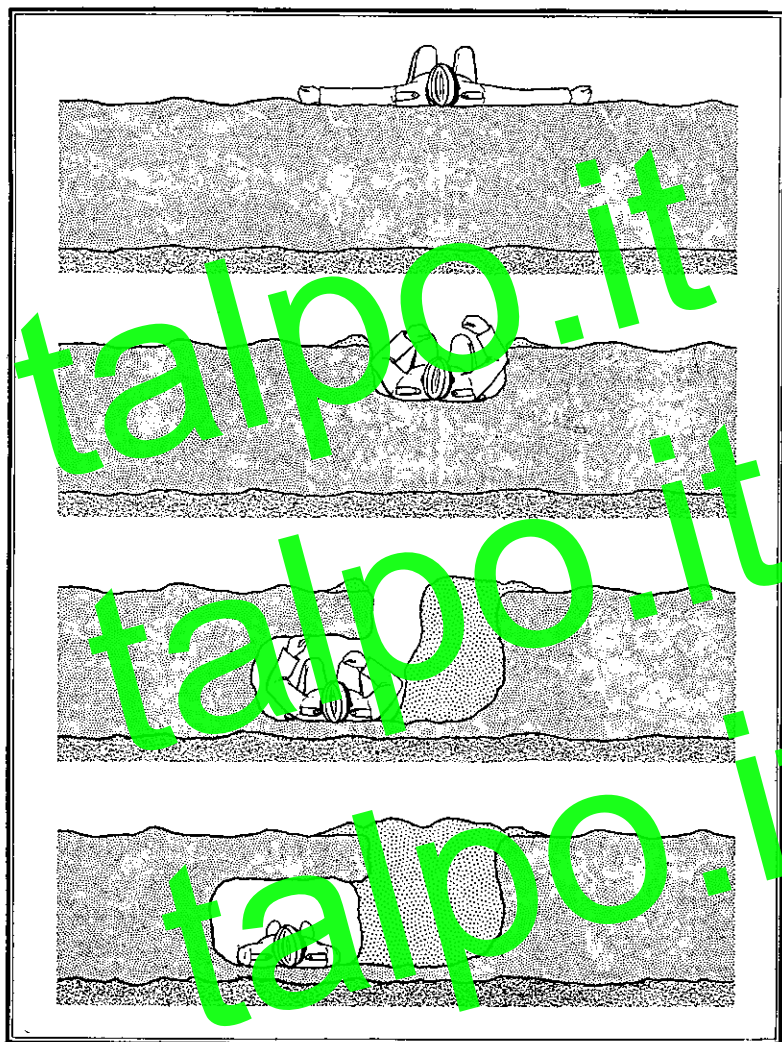


Figure 20.—Making a snow hole without tools.

width of his shoulders. When he has reached a 20-inch depth, he digs himself in sideways below the surface, and then fills in the original ditch with the snow he has ex-

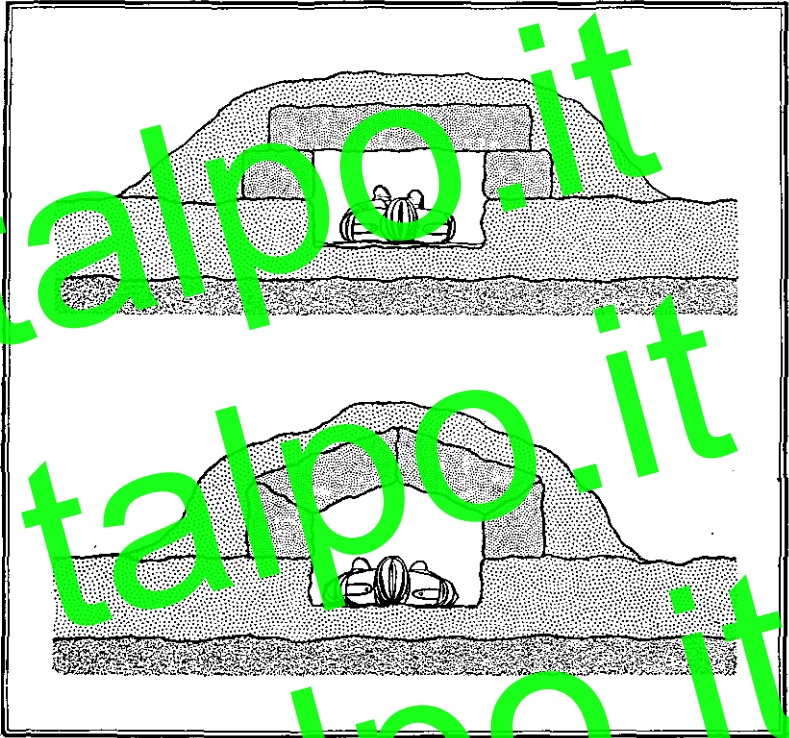


Figure 21.—Types of snow hole.

cavated until only a small opening remains. This opening may be entirely closed, depending upon the enemy situation and the temperature. The smaller the shelter, the warmer it will be. In snow of lesser depth an open snow hole is dug and covered with snow blocks (fig. 21).

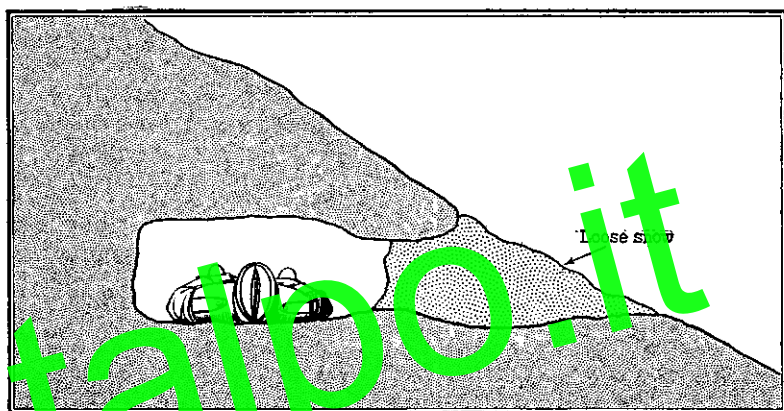


Figure 22.—Cave in snowdrift.

18. SNOW CAVE

One may dig a cave still more rapidly in a snowdrift. If the entrance is made to slope upward, the cave will be especially well protected against the penetration of cold air (fig. 22.) Snow caves may be built for several men if the

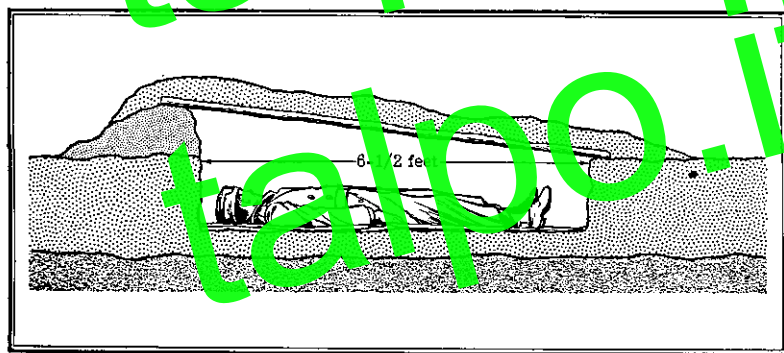


Figure 23.—Snow pit for several men.

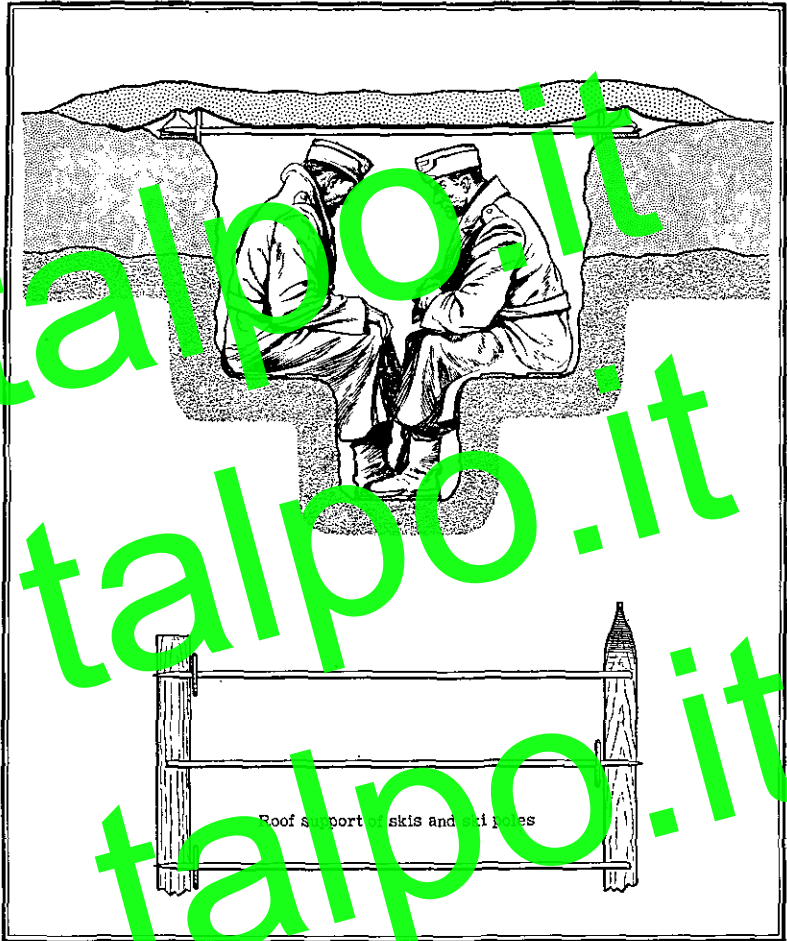


Figure 24.—Snow pit in deep snow.

consistency of the snow is such that it will not cave in. To expedite construction, the work is started from two entrances. One entrance is sealed after completion of the cave.

19. SNOW PIT

The snow pit is dug vertically into the snow in the same fashion as the snow hole, but it is larger and rectangular. Skis, sticks, poles, branches, shelter valves, and snow are used as roofing. The pit affords shelter for several men in a prone position. It is advisable to slope the roof down toward the foot end (see fig. 23). In very deep snow, the snow pit may be sunk deep enough to accommodate two men sitting or standing (fig. 24). If the snow is not deep enough, the sides of the pit are made higher by adding snow walls upon which are laid skis or similar supports for a roof (fig. 25).

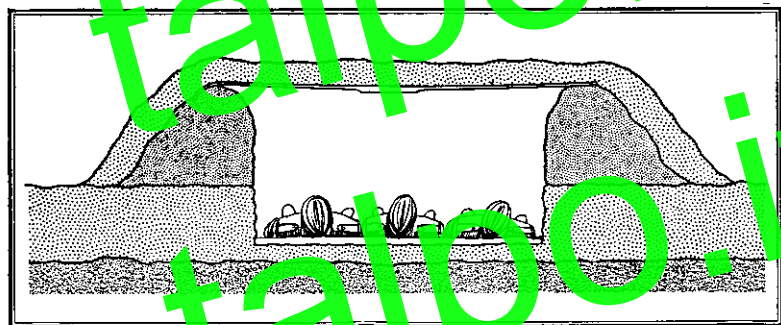


Figure 25.—Snow pit in shallow snow.

20. SNOW HOUSE

The size and the roof of snow houses are similar to those of snow pits. The side walls, however, consist of snow

blocks and may be built, even in case of a light snow, up to the height of a man. Snow piled on the outside seals the cracks and camouflages the building (fig. 26).

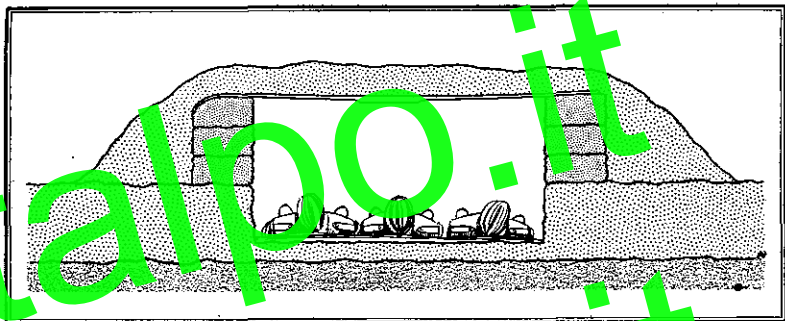


Figure 26.—Snow house with walls of ice blocks.

21. IGLOO, ESKIMO TYPE

a. General

The Eskimo type of igloo (*Iglu nach Eskimoart*) is a very useful shelter and can be built easily if the snow is deep enough and of the right consistency. It is especially valuable in treeless, uninhabited areas, or when tents are not available. Its construction requires practice and familiarity with snow as a material.

The igloo is a domed house made of snow blocks. It offers protection against wind, cold, rifle and machine-gun fire, and shell fragments. It can be used in many ways—as a shelter, sentry box, firing position, pillbox, dressing station, refrigerator for foods, and shelter for horses and motor vehicles. It can be occupied throughout the winter. The colder it is outside, the more comfortable the igloo

will be. Outside temperatures of about -58 degrees F. are not felt within the building.

The igloo can hold from 4 to 50 men, depending on its size ($6\frac{1}{2}$ to 26 feet interior diameter). For a short stay, a small igloo is preferable; for a long stay, a large one. If the snow is of poor quality, several small igloos can be built more quickly than one large one.

The standard igloo has a diameter of 16 feet, measured through the thickness of the snow blocks, and an interior diameter of 12 feet. It is 6 $\frac{1}{2}$ feet high inside, and its walls are 19 inches thick, not including the snow piled around the outside. It has proved to be especially practical as a shelter for 12 men. Skilled troops can build it in 1 $\frac{1}{2}$ hours; unskilled men require 2 to 3 hours.

b. Building Equipment

The equipment necessary for constructing igloos consists of the following:

- 3 whipsaws or fessaws (length of blades, 16 to 20 inches) for cutting and trimming snow blocks.
- 4 long-handled saws with cross grips for lifting snow blocks.
- 2 hatchets for cutting ice.
- 1 hand sled for carrying snow blocks.
- 1 wooden form (trapezoid shape) for measuring snow blocks.
- 4 field spades for carving snow blocks.
- 1 piece of string, 10 feet long, for use as a ground compass and plumb-line during construction.

c. Condition of Snow

Dry, hard snow, from which snow blocks can be cut quickly, is best suited for building an igloo. Frozen snow is less suitable; fresh powdery snow is useless. The thickness and solidity of the snow are tested by probing with the

saw. The snow should be at least 12 inches thick. The lower layers under powdery snow may be cut into blocks after the loose snow is removed. Thawing snow can always be used for building an igloo. If the snow is not deep, large snowballs can be made by rolling; then blocks are cut out. The thicker the blocks, the more quickly the building will be finished.



Figure 27. Cutting snow blocks.

d. Preparation for Building

To construct a standard igloo, a center point for it is fixed by driving a field spade on a wooden peg into the ground. The measuring line is tied to one space or peg at snow level. Distances of 6 feet 5 inches and 8 feet from the spade are marked by knots in the line, and circles are drawn around the spade at these distances. Between the two circles is laid the foundation for the igloo wall. The building site must be leveled, and soft snow must be packed

down or removed. In deep snow the lower part of the igloo can be dug out and a dome built over it.

e. Cutting the Blocks

The snow blocks are cut out of a pit with vertical walls 12 to 20 inches deep. Standing in the pit, a man cuts out

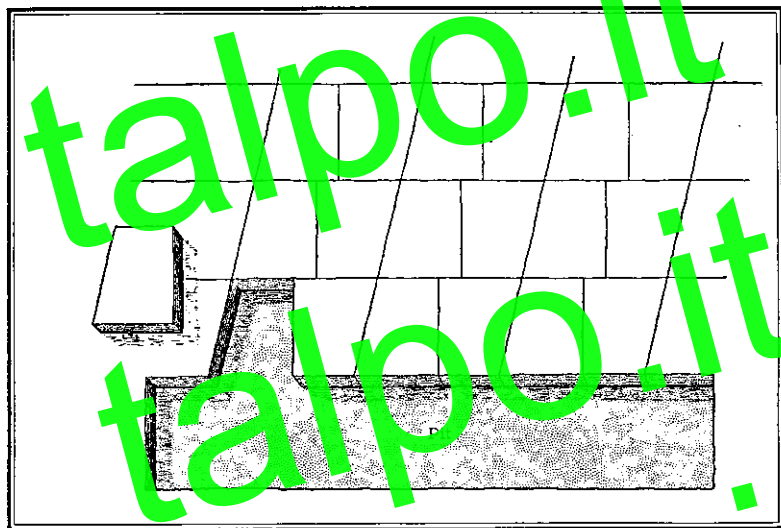


Figure 28.—Pattern formed in cutting snow blocks.

blocks along the edge of the pit in order to obtain perpendicular (not slanting) surfaces (fig. 27 (3)). It is advisable, especially for beginners, to use a wooden form of the trapezoid shape (fig. 27 (2)) which all the blocks must have. In cutting the blocks, the long and the short parallel sides are alternately placed on the edge of the pit. The resulting pattern is shown in figure 28.

The blocks should be lifted out carefully with one or two shovels in order to avoid damaging their surfaces.