MAINTENANCE, REPAIR, AND REHABILITATION OF ROADS, AIRFIELDS, AND HELIPORTS

CHAPTER 8

Maintenance is the routine prevention and correction of normal damage and deterioration (from use and the elements) to keep road and airfield surfaces and facilities in usable condition. Repair is that work necessary (other than maintenance) to correct damage caused by abnormal use, accidents, hostile forces, and severe weather. Repair includes the resurfacing of a road or runway when maintenance can no longer accomplish its purpose. Based on this manual, rehabilitation is the restoration of captured airfields and heliports to usable condition. Rehabilitation resembles war-damage repair except that it is accomplished before occupancy.

MAINTENANCE AND REPAIR CONSIDERATIONS

The purpose of all maintenance and repair activities is to keep roads, airfields, or other installation surfaces in as usable and as safe a condition as the situation permits. Prompt and adequate maintenance is important. Once surface deterioration or destruction has started, it can proceed very rapidly. Postponing minor maintenance jobs can result in the development of major repair jobs involving the subgrade, base course, and surface.

Use the following guidelines when performing maintenance and repair work:

- Ensure that maintenance and repair activities interfere as little as possible with the normal flow of traffic. Whenever feasible, plan and perform maintenance and repair activities to permit at least partial use of the facility. When it is necessary to close the facility to all traffic, select alternative facilities or perform repair work at night or during periods of reduced activity. Reopen the facility as soon as practicable.

- Remedy the cause before repairing the problem. For example, surface repairs made on a defective subgrade are wasted. All maintenance and repair jobs should include an investigation to find the cause of the damage or deterioration. To ignore the cause is to invite the prompt reappearance of damage. Ignore the cause only when making temporary repairs to meet immediate, minimum needs under combat or other urgent conditions.

- Maintain and repair existing surfaces as closely as possible to the original construction in strength, appearance, and texture. Spot strengthening may create differences in wear and traffic impact that can harm adjoining surfaces. Also, uniformity simplifies maintenance and repair operations.

- Prioritize the needed repairs based on the tactical requirements, the traffic volume, and the hazards that result from complete failure of the facility. For example, roads used for tactical-operations support take priority over less essential facilities. One pothole in a heavily used road that is in otherwise excellent condition takes priority over repairs to less heavily used roads in poor condition.

MAINTENANCE AND REPAIR OPERATIONS

Maintenance and repair operations include many tasks besides improving the pavement condition. To ensure a comprehensive maintenance and repair operation, incorporate the following tasks:

- Routine inspections.
- Material stockpiling.
- Maintenance and repair of all related drainage systems.
- Maintenance and repair of the actual pavement, including dust and mud control and snow and ice removal.
- Miscellaneous tasks, including the maintenance and repair of necessary buildings, structures, and utilities, and the operation of necessary utilities.

MAINTENANCE INSPECTIONS

The purpose of maintenance inspections is to detect early evidence of defects before actual failure occurs. Frequent inspections and effective follow-up procedures prevent minor defects from becoming major repair jobs. Inspect surface and drainage systems carefully during rainy seasons and spring thaws and after heavy storms.

Surface Inspection

Surface defects can usually be attributed to excessive loads, inferior surfacing material, poor subgrade or base conditions, inadequate drainage, or a combination of these conditions. Surface inspections should include a complete inventory of the current pavement defects. Careful investigation of the causes of the defects will allow for timely maintenance to prevent the pavement defects from requiring repair.

Drainage Inspection

Ensure that all drainage channels and structures arc unobstructed. Check culverts and drainage lines for structural damage. Inspect check dams for debris and excessive erosion. Investigate water ponding on or adjacent to surfaced areas. Inspect the system drainage during or after every storm. Also, thoroughly inspect the system in late fall to prepare for winter and in early spring to ensure minimum spring breakup difficulties. Inspect subsurface drains at least twice a year.

MATERIALS FOR MAINTENANCE

Generally, materials required in the maintenance and repair of roads and airfields arc the same as those used in new construction. Open pits and prepare stockpiles of sand and gravel; base material; and premixed, cold patching materials at convenient places and in sufficient quantities for emergencey maintenance and repair. Arrange stockpiles for quick loading and transporting to the road or runway. Build onc of the several types of trap-and-chute combinations described in Chapter 5 of TM 5-332 for sand, gravel, and base materials, Premixed. cold patching material may be prepared as explained in Chapter 9 of TM 5-337. Maintain small quantities of aggregate in dry storage for concrete patching.

DRAINAGE MAINTENANCE

Defective or inadequate drainage causes most pavement failures and deterioration. Pending or delayed runoff of surface water allows seepage into the pavement structure unless the surface is tightly sealed.

Surface Drainage

Mark areas where pending occurs on sur - faced areas. Correct such problems by filling or raising depressions and by providing outlets for water blocked by high shoulders. Control penetration of storm water through pavement by scaling joints and cracks. Keep unpaved roads and airfields crowned to prevent water from remaining on the road or airfield where it will saturate and weather the surface. Maintain crowns and superelevations with graders or drags.

Shoulders

Keep shoulders smooth and graded so water will drain from the surfaced area toward the ditch. Replace eroded shoulder material on paved surfaces with new material. Material cleaned out of ditches can often be used 10 rebuild shoulders. Shoulders should be kept bladed flush to, or slightly below, the edges of the pavement and should slope away from the pavement to prevent water seepage into the subgrade.

Drainage Ditches

Keep drainage ditches clear of weeds. brush. sediment. and other debris that obstruct water flow. Maintain ditches as to line and grade. Correct sags and minor washouts as they occur. Side ditches can usually be maintained with graders.

When cleaning and shaping, avoid unnecessary blading or cutting that destroys natural ground cover. Where possible, develop dense sod to stabilize open ditches. Where vegetation is not effective because of soil or moisture conditions, erosion may be corrected by lining the ditch with riprap, asphalt-coated membrane, or concrete.

Inspect check dams in side ditches and clean them regularly. The weir notch of a check clam must be kept clean or water will cut into the surfaced area at the edge of the dam (Figure 8-1). The aprons of check dams must also be maintained, and paving material must be replaced when washed out. Dikes or berms may be required along the tops of high-fill slopes to prevent gullies and washes.

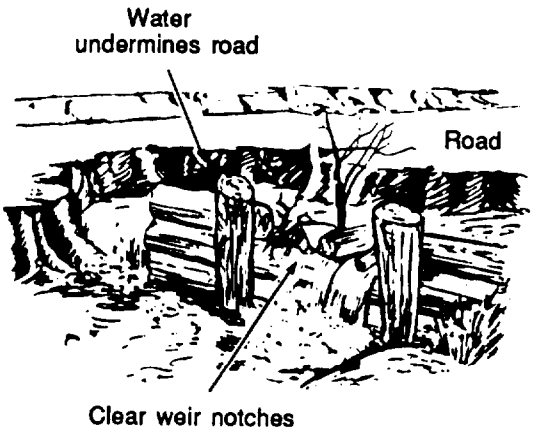

Figure 8-1. Check dam

Cut-slope interceptor ditches must be considered for all side-hill and through cuts to prevent gully washing and erosion from the top of the cuts. If benching or terracing has been used in the design of the cut, ensure that the top of each bench is sloped back into the cut to provide for proper drainage. Also ensure that each bench top is wide enough to maintain that drainage with earthmoving equipment. A good rule of thumb is to make benches at least as wide as a dozer blade. Figure 8-2, page 8-4, illustrates proper terraced side-hill-cut drainage.

For proper design considerations of cut slopes, refer to Chapter 10 of FM 5-410.

Culverts

Keep culverts clear of debris and sediment (Figure 8-3, page 8-4). This prevents water from cutting around or undermining the culverts. Inspect culverts frequently to determine whether they arc func-tioning properly. Cleaning by hand is usually necessary after heavy rains.

NONPAVED SURFACES

Basic maintenance of nonpaved surfaces includes shaping the cross section to maintain adequate drainage anti a smooth, compacted surface.

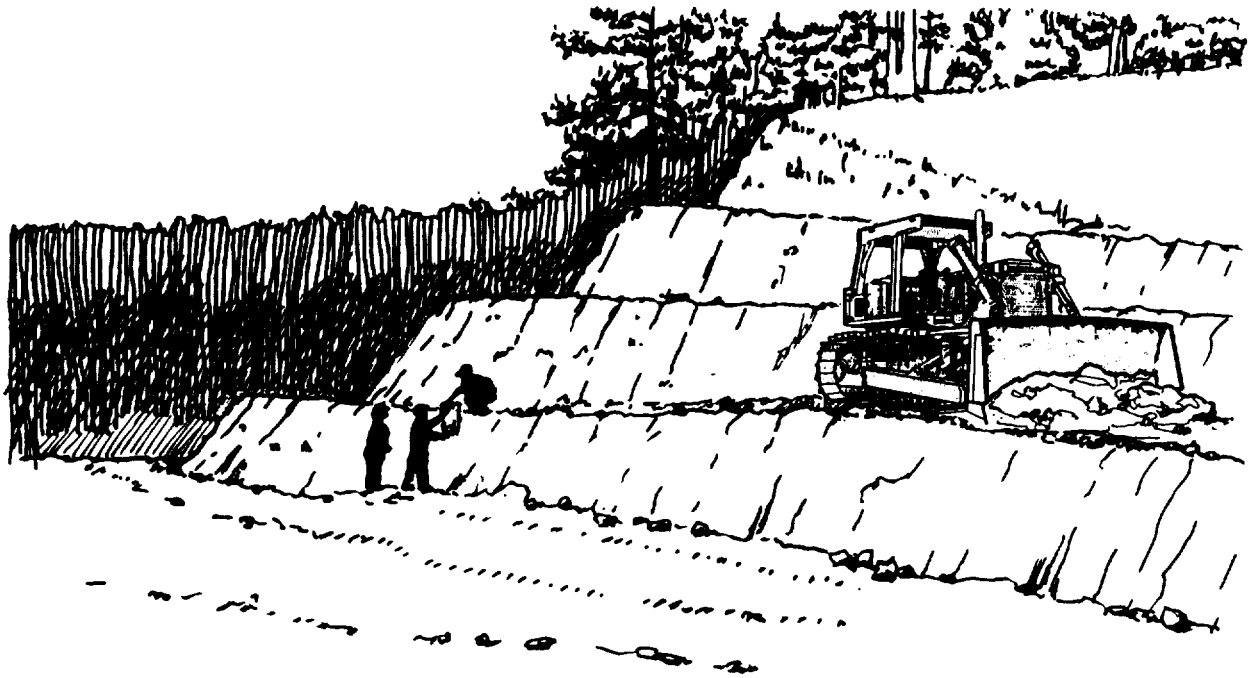

Figure 8-2. Side-hill terracing

Equipment

Most surface maintenance consists of light scraping with grader blades and drags. Multiple-blade drags of iron or iron-shod, heavy timber may be used for normal scraping. Drags are frequently used to float mud and water off a road and to prevent corrugation or washboarding of the surface. One type of drag is shown in Figure 8-4.

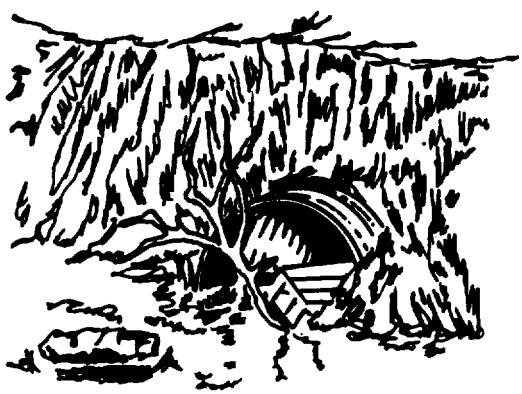

Figure 8-3. Culvert entrance

Materials

Materials removed from ditches, other than silt, some clays, and all organic soils (OL, OH, Pt), may be used on shoulders and traveled ways. Dispose of silt deposits when removed; they are not suitable for construction. After heavy storms and spring thaws, additional material may need to be hauled in.

Procedures

Keep traffic areas and shoulders free of potholes, ruts, and irregularities. Light blading will prevent corrugation or washboarding. Work from the ditches to the center of the road to ensure good drainage and proper road crowning. Since loosened, dry material cannot be compacted, blading or dragging should be done during or soon after rains. For prolonged dry spells or when surface material will not compact, add water or moist subsurface material

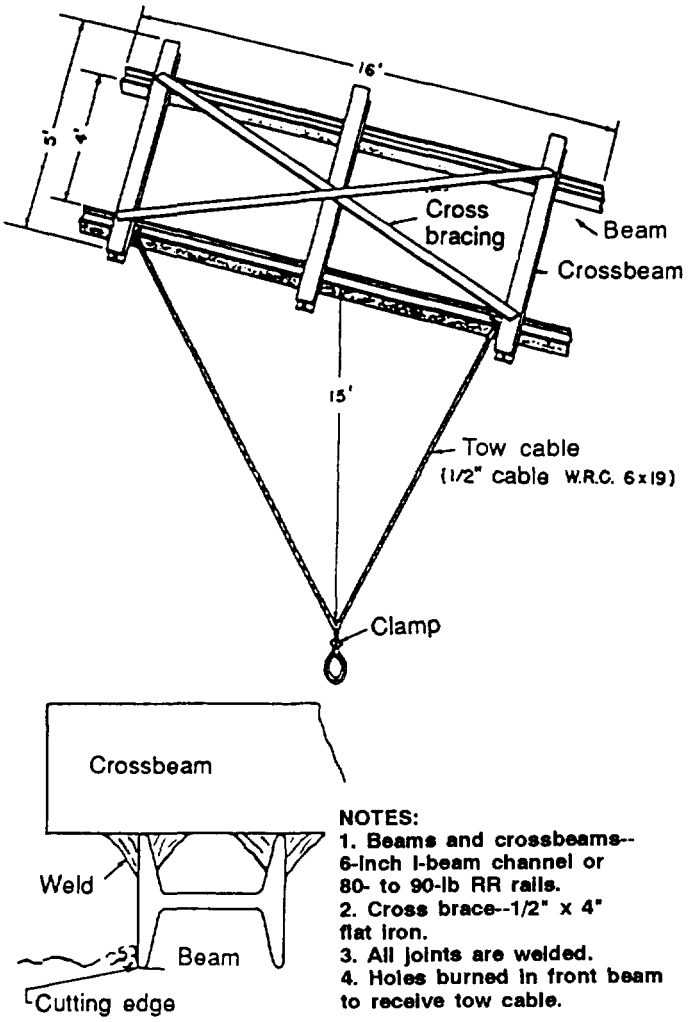

Figure 8-4. Improvised road drag

with a rototiller, plow, or scarifier before compaction.

Compaction of the graded surface material will reduce maintenance and repair for nonpaved surfaces. The type of roller used will vary with the material compacted. The correct moisture content will result in the most economical compaction.

Soft spots, indicated by rutting or shoving of the surface, are generally caused by excess moisture, poor subsurface drainage, or unstable material. Determine the source of excess moisture and correct the drainage. On traffic areas, cobbles may be used to stabilize small areas of failure. Where surface failures are caused by pockets of mulch or peat, it may be necessary to remove the objectionable material and replace it with a more stable material. When adequate repairs cannot be made, soft spots can be temporarily reinforced by adding crushed rock or clean gravel.

Keep non paved surfaces crowned to prevent water from remaining on the surface and saturating the soil. Maintain the crown and superelevation with drags or graders.

Dust control may be a problem under some conditions. Spraying with water or a bituminous stabilizer is the most commonly used method of controlling dust. Dust control is discussed further in Chapter 12 of FM 5-430-00-2/AFPAM 32-8013, Vol 2.

Examples of road repairs are shown in Figure 8-5, page 8-6.

OILED SURFACES

The routine maintenance of oiled surfaces consists of shaping and patching. Shaping is done with graders or drags. Patching may be done with a mixture of the soil and oil. Oiling is necessary each year because oiled surfaces frequently break up in the spring and become very rough. Thorough scarifying. blading (or dragging), and reshaping is necessary before oiling each year.

GRAVEL SURFACES

Maintenance procedures for gravel surfaces are much the same as for nonpaved surfaces. Continual shaping is needed to maintain a smooth surface and a uniform crown, and the drainage system must be kept functioning.

Surface Maintenance

Heavily-traveled, graveled surfaces require constant attention by maintenance patrols. Intensive maintenance is required when the surface is first open to travel. Bumps compacted at this time remain in the surface and can be corrected only by scarifying or adding more material. Blade or drag the surface soon after rain until all ruts and holes are filled. Do not work on a dry

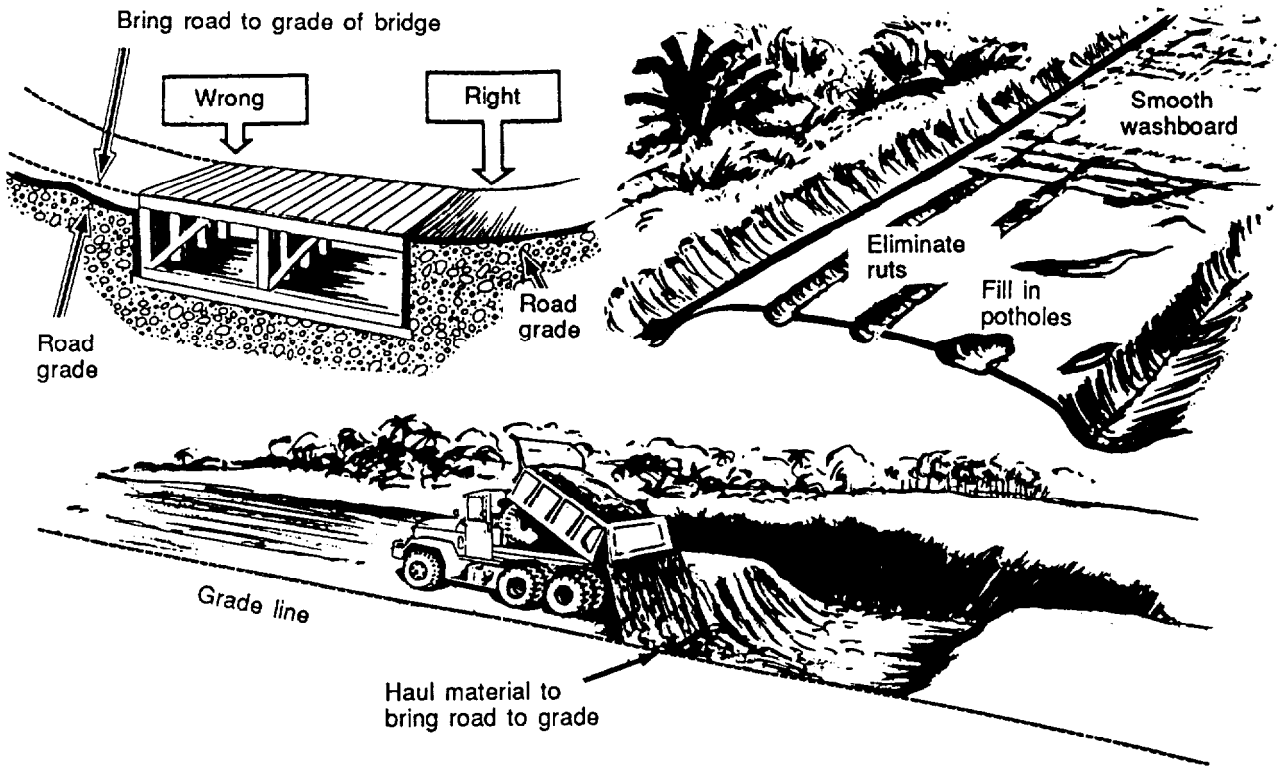

Figure 8-5. Road maintenance problems and proper corrective action

surface. Maintain a crown of at least 1/2 inch per foot. Multiple blade drags or sled drags can be used for routine maintenance, but graders are necessary for heavy reshaping work.

Keep a slight excess of gravel available at the edges of the roadway and blade it uniformly over the surface in wet weather. Stockpile additional materials in advance of fall and winter and prolonged wet periods. Material added or spread on the surface during warm, dry weather is of little value.

Repair of Potholes

Most potholes are caused by material displaced by traffic. Initially they are shallow and are readily filled by blading when the surface is moist. Deep holes require filling with additional material. New material should be moistened and compacted.

Treatment of Corrugations

All gravel surfaces tend to develop transverse or nearly transverse waves, called corrugations, which may progress into ruts as deep as 4 inches and from 1 1/2 to 3 feet apart. After this stage, they become major grooves needing extensive repair.

Some blade equipment inherently chatters and starts slight irregularities, especially when the operator attempts to move a heavy cut. Corrugations often appear to start from small holes or depressions made when the road is wet or from an obstruction such as a stick or rock. Other contributing factors are a soft subgrade, poor grading of the gravel, poor binder, and an insufficient amount of binder.

Corrugations can be prevented to a considerable extent by frequent maintenance and by the careful use of maintenance equipment. Once corrugations form, they can be

removed only by thoroughly scarifying, reshaping, and compacting. Regrading, as this is called, should begin with a thorough cleaning and reshaping of the shoulders and ditches, continuing across the entire roadway.

Use of Calcium Chloride

Calcium chloride may be applied to a gravel surface to control or eliminate dust, prevent the loss of material under the whipping action of traffic, and aid in maintaining a dense surface. The usual method is to apply 1 pound of calcium chloride per square yard in the late spring and 1/2 pound per square yard twice during the summer season. However, the amount of rain, the volume of traffic, and the character of the gravel affect the quantities required. Calcium chloride is corrosive to metal surfaces and may require more maintenance for aircraft and vehicles.

The best time to apply calcium chloride is following a rain and after necessary blading or dragging is completed. If the application cannot be deferred until rain occurs, water the surface before applying the calcium chloride. For best results, apply calcium chloride before the traffic area becomes dry and dusty.

PROCESSED MATERIAL SURFACES

Traffic areas composed of processed materials (crushed and screened rock, gravel, or slag) are maintained by methods similar to those used on gravel surfaces. When coarse, processed materials are used, surface failures are usually in the form of sharp-edged holes caused by poor drainage. Repairs require cleaning the holes down to the solid subgrade and ensuring that no silt, mud, or water remains. Subgrade repairs are then made with a well-graded soil aggregate. Surface repairs should consist of a well-tamped or rolled-in-place, coarse-graded aggregate of the same gradation as the original surrounding surface.

BITUMINOUS SURFACES

The maintenance and repair of bituminous surfaces are discussed in Chapter 9 of TM 5-337. Some considerations applicable to bituminous-surfaced traffic areas follow.

Inspection

Maintenance patrols should frequently inspect bituminous pavements for early detection of failures. Small defects quickly develop into large ones, resulting in pavement failure unless promptly corrected. Small crews using hand tools can quickly make minor repairs with a minimum interruption of traffic. Large, bituminous repairs require more time, personnel, and equipment. Such repairs also interfere with traffic. In extreme cases, detours may be required to avoid complete traffic stoppage.

Patches

All patches should be trimmed square or oblong with straight, vertical sides running parallel and perpendicular to the centerline of the traffic area, as explained in Chapter 9 of TM 5-337.

Temporary Repairs

Any stable material may be used for temporary repairs in combat areas or where suitable material is not available and the traffic area must be patched to keep traffic moving, Good-quality soil and masonry, such as concrete rubble, are suitable for this purpose. All such patches must be thoroughly compacted and constantly maintained with replacement material. More permanent patching should be accomplished as soon as possible.

Maintenance of Shoulders

Blade shoulders so water drains from the surface and all ruts and washouts are filled. Grade shoulder material flush against or slightly below pavement edges to restrict water seepage to the subgrade and to prevent breaking of the pavement edge caused by traffic driving off the pavement onto the shoulder. Replace material displaced from shoulders with material hauled in, as required.

STABILIZED SOIL SURFACES

Maintenance of mechanically-stabilized soil surfaces and sand-clay surfaces is essentially the same as that for nonpaved and gravel surfaces. Procedures described for gravel surfaces arc applicable to surfaces that contain considerable coarse aggregate. Procedures described for nonpaved surfaces are applicable to surfaces that contain little or no coarse aggregate. Bituminous surfaces, soils, and soil-cement may require additional maintenance as described in the paragraphs that follow.

Potholes

Clean potholes and trim them rectangularly with straight, vertical sides running parallel and perpendicular to the centerline. This provides a shoulder against the movement of the patch. Fill the potholes with a stabilized mix of the same character as the adjacent sound area. This material should be thoroughly compacted in place, one thin layer at a time.

Ravels

Edge raveling is caused by water softening the foundation material. Before proceeding with the patching operations, reconstruct the shoulder or lower the subdrainage so this condition will not recur. Then build up the foundation. The patching mixture should conform 10 the surrounding area, as for pothole repair.

CORAL SURFACES

The maintenance of well-built coral traffic areas is relatively simple. Use fresh, raw coral of the proper moisture content for the repair material. Maintenance is best done during or after a rain while the coral is wet. Fill low spots, ruts, and potholes by shoveling or dumping coral directly from a truck onto the low spots. Such patches, if rolled while wet, will bond onto the original material almost without a mark. Salt water is usually available where coral is available, and salt water makes a better bond than fresh water.

Occasional blading and rolling are necessary to maintain a proper crown and a smooth surface. In dry seasons, sprinkling is necessary to maintain a proper crown, a smooth surface, and high stability and to minimize dust. The traffic areas hold up well in wet seasons. An asphalt treatment may be justified in prolonged dry seasons, if dust and raveling become serious. Careful attention to shoulders and to the drainage system is essential.

RIGID PAVEMENTS

Maintenance of rigid pavements is covered in Chapter 15 of TM 5-337. Frequently inspect concrete pavement to detect early signs of failure, and make prompt repairs to prevent minor defects from spreading.

CRATER REPAIR

Bombs, shells, land mines, and cratering charges can produce extensive craters in traffic areas. Surface damage does not present any unusual repair problem, but explosions may displace or destabilize large areas of the subgrade. Drainage may also be disrupted, allowing water penetrating the broken surface to accumulate and further soften the subgrade. Satisfactory repairs require the restoration of subgrade stability to support traffic and prevent undue surface settling after repairs have been completed.

Use the following procedures for crater repairs:

1. Remove, from around the edge of the crater, all surfacing that is damaged or not firmly bonded to the base course.

2. Trim the surface and base course to a sound, vertical edge.

3. Remove water, mud, and debris from the crater.

4. Fill the crater with successive 6- to 8-inch layers of suitable material to the original level of the subgrade. Compaction is essential; each layer must be thoroughly

tamped with hand or pneumatic tamping tools. After the material has reached a suitable level, compaction equipment can be pulled through or driven across the crater.

5. Repair the base course and wearing surface.

Gravel, rock, masonry debris, sandy soil, or other suitable, stable materials can be used to fill craters, as shown in Figure 8-6. Material blown from craters can be used for much of this fill. In an emergency. material from the shoulders of roads or airfields may be borrowed and replaced later. When the situation permits and where enemy action may be anticipated, stockpiles or material pits should be prepared at convenient sites. Alternate layers of sandbags and tamped earth allow good subgrade compaction where other equipment or materials are not available.

For a detailed discussion of specific crater repair techniques used in air-base damage repair, refer to Training Circular (TC) 5-340.

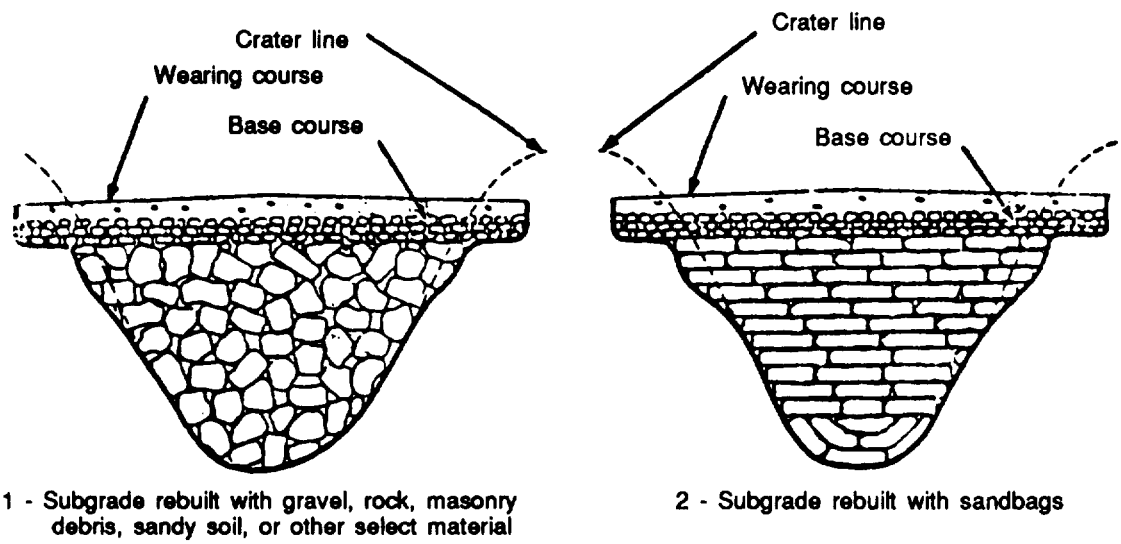

Figure 8-6. Crater backfill materials

ROAD MAINTENANCE

The importance of preventive maintenance and the necessity for prompt maintenance of all types cannot be overemphasized. Neglect and delay permit the traffic and weather to turn minor defects in 10 major problems. Progressive failure of roads is a serious matter. The more serious a failure is, the more quickly it deteriorates.

In forward areas, extensive repairs are often necessary before roads can be used. Expedient work is usually done by combat engineer units. Under the pressure of combat conditions, temporary repairs are made hurriedly using the materials most readily available. Such repairs are intended only to meet immediate minimum needs. As the advance units move forward, other engineer units lake over the work of additional repair and maintenance. Epedient repairs previously made arc supplemen ted or replaced by more permanent work. Surfaces are brought to a standard that will withstand the required use and maintenance becomes routine.

MAINTENANCE PATROLS

Adequate maintenance requires a workable maintenance organization. Usually engineer units establish a patrol system to handle the roadnet for which the unit is responsible. It is desirable to use squads as patrols and thus retain unit integrity, with each squad commanded by its squad leader and using its regular table(s) of organization and equipment (TOE). The platoon furnishes reinforcements (personnel or equipment) as needed.

Assign each patrol to a specific area. Organize as many patrols as necessary to adequately cover the total area of responsibility. It is sometimes necessary in forward or heavy-traffic areas to provide enough patrols to put the maintenance function on a 24-hour-a-day basis.

Personnel and Equipment

Two plans are presented for the organization of maintenance patrols. Consider the merits of each plan with respect to the maintenance problems of the situation and the personnel and equipment available for the patrols.

One patrol consists of a normal squad equipped with a dump truck, a grader, and hand tools. This patrol can handle all the maintenance and minor repairs normally en countered on a 5- to 15-mile stretch of road. The number of people in a squad “can be decreased and more miles can be assigned to a patrol expected to cover a stretch of permanent pavement in good condition and not heavily traveled. If a patrol is to cover a poor dirt road accommodating heavy traffic, more personnel will be furnished by the platoon and fewer miles will be assigned.

Another plan calls for the assignment of a patrol of one to three people, a grader, and hand tools. This crew can handle the routine maintenance on a 12-mile stretch of average earth, gravel, or water-bound macadam road. However, the crew must be supplemented with a truck and repair crew whenever material must be hauled or surface patching accomplished.

Winter weather; severe storms; heavy, destructive enemy action; and other conditions demand that the patrols be reinforced with additional personnel and equipment or that the assigned areas be reduced and the number of patrols increased. Special conditions often call for special equipment.

Duties

The duties of maintenance patrols are as follows:

- Clean out drainage facilities.
- Mow grass and weeds.
- Repair minor washouts and potholes.
- Maintain the road surface; for example, eliminate ruts, potholes, and washboards.
- Maintain road shoulders and ditches.
- Make frequent, thorough inspections of road conditions, and report to higher headquarters any need for repair work more significant than the patrol is equipped or manned to handle.

Inspection and Supervision

An officer or senior noncommissioned officer (NCO) is assigned several patrols to supervise, assist, and inspect. Normal unit organization should be retained as much as possible. A platoon leader should be responsible for the patrols composed of personnel from his command.

REPAIR CREWS

The engineer sending out maintenance patrols should keep sufficient equipment and personnel available to send out repair crews to handle those situations reported by the patrols. The repair crew composition will be dictated by the needs of the particular job in terms of equipment and personnel. Frequently, the regular maintenance patrol can work with the repair

crew, but other maintenance and inspection of the patrol's area must not be neglected.

MAINTENANCE WITH TRAFFIC

Give full consideration to the importance of keeping traffic flowing with a minimum of interference or delay. Maintenance of shoulders and ditches can normally be performed without interference from, or hindrance to, traffic. Repairs to other drainage structures may delay traffic or slow other repair work. Permanent repairs are often postponed so that temporary and emergency repairs can be made in order to maintain traffic flow.

Traffic Control

Repairs should be made on one-half the surface at a time when surface repairs will deny traffic the use of sections of the pavement. Block off short sections and post guides to regulate traffic and avoid delay.

When single-lane traffic must be used, control traffic by the baton method. With this method, a flagman is placed at each end of the single-lane traffic section. The flagman at one end of the section has a baton or some other distinctive marker. Working under a prepared plan, all vehicles traveling in one direction are stopped, while those traveling in the opposite direction are permitted to go through. After a suitable time interval, the flagman on the open end of the section gives the baton to the driver of the last vehicle permitted to go through. Upon arrival at the other end of the section, the driver of the last vehicle gives the baton to the flagman. Vehicles are then permitted to travel in the opposite direction until all waiting vehicles have passed through and the driver of the last vehicle carries the baton to the other end of the section. This process continues as long as necessary.

Sometimes two-way traffic can be maintained through blocked-off sections by diverting one stream of traffic to the shoulder of the road. Grading and stabilization of the shoulder with gravel or bituminous material may be justified in such instances. Repairs to be performed during traffic flow should be carefully planned; proper procedures should be selected; and all labor, material, and equipment should be on hand to complete the work as rapidly as possible.

Bypasses and Detours

Bridge or pavement failures or the destruction of part of a roadway by floods or combat action may make part or all of the roadway impassable to traffic. In such cases, a bypass or detour around the damaged or obstructed area is necessary. The construction of a short bypass around an obstruction may be preferable to a longer detour on existing roads. A detour may also be used while a bypass is being constructed. Base the decision upon traffic interference, the work involved, and the time available.

Conduct a reconnaissance to determine the best possible route when establishing a detour. The road should be as short as possible and must be in condition, or be put in condition, to handle traffic for the period when it will be used. Use existing roads when possible. Construct short sections of connecting roads, if necessary.

Check and repair bridges or reinforce them with timber or planking. Clean and repair culverts. If the need for a detour is anticipated, complete this work beforehand. Detour roads are usually subjected to heavier loads and more traffic than their design specifications. Because increased maintenance is usually required to keep detours passable, stockpile surfacing material along the route, carefully plan maintenance operations, and keep labor and material constantly available.

Place signs at detour entrances, road intersections, and turns to direct traffic. Post warning signs at dangerous points. Place other signs or markings, as required, to ensure minimum traffic delay. Install barricades at each end of the road section under repair. Refer to Chapter 8 of FM 5-36 for the types and posting of road signs.

Safety of Maintenance Personnel

Give special attention to the safety of maintenance personnel working where traffic moves past or around them. Use restrictive speed and warning signs, barricades, and flagmen to control traffic and lessen the danger to maintenance personnel. Instruct crew members to avoid stepping into the traveled way and to be continually alert to passing traffic. Conspicuously mark maintenance vehicles operating in or on the edge of the roadway with red flags, flashing red lights, or similar devices.

WINTER MAINTENANCE

Winter weather may present special prob - lems in TO maintenance. Regions of heavy snowfall require special equipment and material to keep pavement and traffic areas in usable condition. Low temperatures cause icing of pavements and frost on subgrade structures. Alternate freezing and thawing may damage surfaces and tend to block drainage systems with ice. Spring thaws may result in both surface and subgrade failure. Winter maintenance consists chiefly of removing snow and ice, sanding icy surfaces, erecting and maintaining snow fences, and keeping drainage systems free from obstruction.

Preparation for Winter

Organize snow-removal crews and place equipment in readiness. Stockpile abrasives and chemicals in locations where they will be required. Perform late fall maintenance before the winter freeze. Continue with routine maintenance of ditches and shoulders as far into the winter as possible, so that the drainage system will be in the best possible condition for the spring runoff.

Keep earth and gravel surfaces smooth and shaped to prevent moisture from entering the subgrade. Smoothing and shaping also prevent snowplow blades from being obstructed by rough, frozen shoulder and surface material. In areas of heavy snowfall, outline bridges, culverts, and narrow places in the road with poles that extend above the snow, and mark these locations for maintenance crews.

Snow Fences

Conduct reconnaissance before winter to determine where snow fences will be needed to control drifting snow. Because it is fine and compacts into a dense mass, drifted snow obstructs traffic more than an equal depth of freshly fallen snow. Drifts form when wind-borne snow is picked up in open spaces, loses velocity, and is deposited in sheltered places. Danger spots, therefore, are roads at ground level or in cuts adjacent to large, open areas. Drifts also form in the lee (down-wind side) of buildings, signboards, and similar wind barriers. Similarly, high snowbanks left close to the road by snowplows furnish both the conditions and the material for extensive drifting. Snow fences are not normally required near high fills, in wooded or brushy areas, or where vegetation prevents snow from drifting on the road.

Placement. Place snow fences on the windward side of roads according to prevailing winds (Figure 8-7). The height of the fence determines the distance it is to be placed from the traveled way. Generally, the proper distance is 20 times the height of the fence. This distance is increased where winds are of high velocity. According to the above ratio, a 4-foot fence erected 1 foot above the ground should be placed at least 80 feet beyond the point where drifting is to be prevented. In extreme cases, a distance as great as 300 feet may be necessary.

Fences should be as long as possible without any holes or openings. Openings provide for dispersion of snow on the back side of the fencing. The effect of a snow fence in controlling drifts caused by a road cut is shown in Figure 8-8. Two or more parallel fences may be required, but one tall fence is generally better than two short ones. If fences are set too far away, they have little or no effect in reducing drifts. If fences are placed too close to the road, drifts to the leeward side of the fence fall on the road.

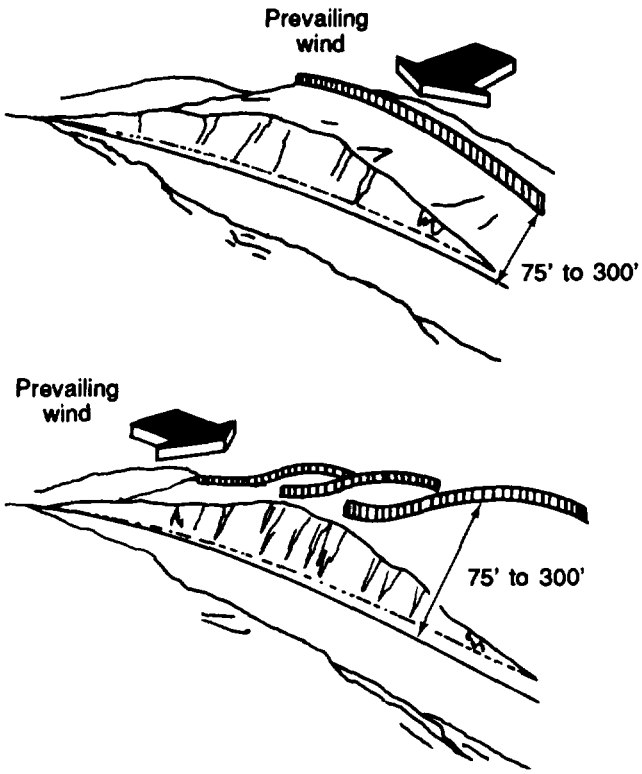

Figure 8-7. Location of snow fences

Types of Snow Fences. Commercial snow fences are commonly used. They consist of metal posts and wooden laths or metal pickets about 5 feet long, woven together with wire. Such fencing is portable, easily erected and dismantled, and may be rolled up and stored in the summer. Permanent snow fences include open-board fences on posts and evergreen or deciduous shrub hedges. Plastic snow fencing is lighter and more efficient than wooden fencing.

Other types of snow fencing include wood slats or pressed-steel slats mounted on collapsible A-frames, worm fences, and brush or branches suspended on wire. Local materials, such as corn stalks, brush, and coarse grass anchored in place by wire or wood, may be used. Figure 8-9, page 8-14, shows three types of snow fences.

Erection. Erect snow fences before the ground is frozen. Drive metal posts into the ground and mount wire fencing on the windward side. In regions of heavy snow, use long posts so that fencing may be raised on the posts as the season progresses. This will increase snow storage to the leeward side. Install fencing with the bottom about 6 inches above ground level to prevent the ends of the pickets from freezing fast and to prevent the fence from choking with snow. Frozen ends make it difficult to raise the fence and may cause the pickets to break when swayed by the wind. Brace the posts according to the anticipated wind velocities.

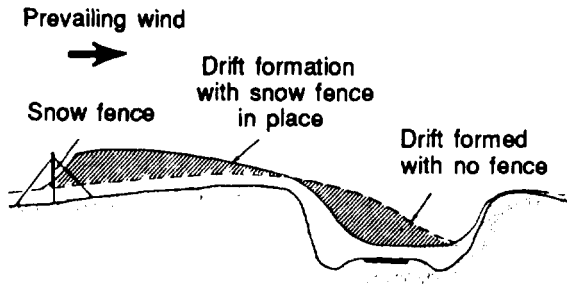

Figure 8-8. Snow fence control of road cut drifts

Maintenance. Inspect snow fences after heavy storms. Repair broken ties and braces, and straighten blown-down sections. Raise fences to exceed the height of accumulated snow on the leeward side. Lowering of fences may be required after midseason thaws or long periods of settling.

Removal and Storage. Remove snow fences in the spring and repair damaged sections. The fences are frequently stored on dunnage at the drift location for use the following winter.

Snow Removal

Prompt snow removal is essential to prevent traffic interference and ice formation on the road. Begin removal operations when the snow starts. The amount of equipment necessary depends on the intensity of the storm. If possible, store equipment at intervals along road sections or roadnets that are to receive early attention, and have operators ready to move promptly when a snowstorm arrives.

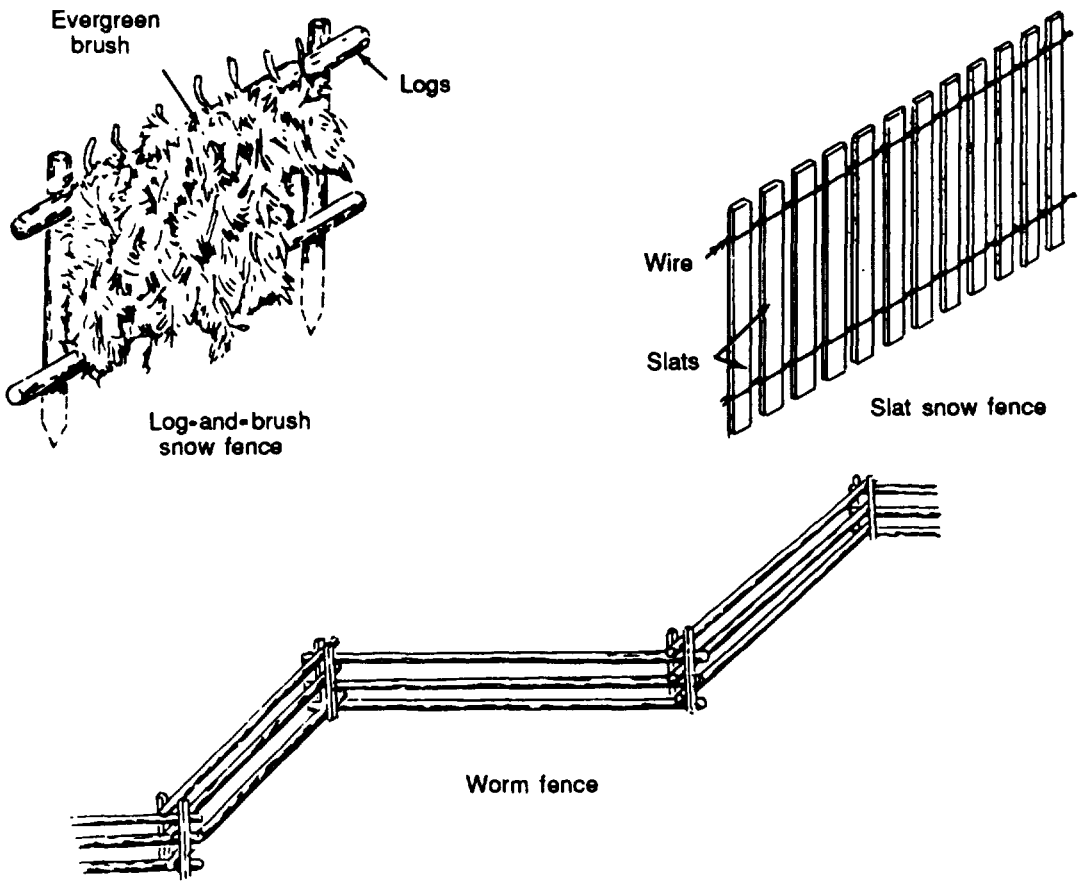

Figure 8-9. Types of snow fences

Provide for relief crews, since snow-removal equipment must frequently be operated on a 24-hour basis during periods of heavy storms. Use snowplows to patrol areas or sections of roads that are subject to drifting in windy weather. Standard snow-removal equipment consists of various attachments mounted on trucks or similar prime movers. These include one-way, reversible, and rotary-type straight blades; straight underbody blades; V-type plows; and rotary snowplows. These items are described in Chapter 11 of TM 5-624. Graders, dozers, and loaders are also useful in snow removal. Improvised equipment, such as drags, may be used in expedient situations.

Use comparatively light and fast snow-removal equipment for light snowfalls and at the beginning of severe storms. Use heavier equipment to widen traffic lanes and for heavy snowfalls. Continue snow-removal operations until the snow has been pushed back, leveled, or hauled to a disposal point. When snow removal is delayed or interrupted, the snow may become too deep for available equipment to handle, drifting may worsen, or wet snow may freeze.

Trucks with 2 1/2- to 5-ton capacities and equipped with one-way blades are best adapted for long stretches of roads. This equipment travels at speeds of 15 to 25 miles per hour (mph), removes snow from the road before it is compacted, and provides an open track for traffic.

Use 5- to 10-ton trucks equipped with either straight or V-shaped blades for heavier snowfalls and to widen traffic lanes. This equipment operates at about 15 mph. Use V-shaped plows to break through heavy drifts. Use either straight or V-shaped plows equipped with side wings to push the snow beyond the shoulder line, to prevent drifting, and to provide room for additional snow storage.

Trucks used for plowing generally carry abrasives as a ballast for better traction. Tractors are sometimes required for heavy snows and drifts. Graders are satisfactory for light snow. In areas of very heavy snowfall, rotary plows and blowers may be needed.

Surface Ice Control

The formation of road ice resulting from packed snow, slush, or melting snowbanks is prevented if snow removal is effectively performed and drainage is provided. When possible, push snowbanks away from pavements so that melted water will not run onto cleared surfaces.

Use plows and graders to remove slush from the road to prevent freezing and icing or to remove ice that has previously formed. Use care to avoid damaging the pavement. Dry snow compacts under traffic but can usually be loosened and bladed off without difficulty. Wet snow or slush, if it is allowed to freeze in place, sticks tightly to the pavement and cannot be easily removed without a period of warm weather or the use of salts.

Various conditions cause icing of road surfaces. Dangerous icing is more likely to occur during the late fall and early spring when frequent temperature changes occur. Midday thawing and night freezing is a common cause of icing. Rain; sleet; or light, wet snow falling on cold pavement can form ice films too thin to be removed by mechanical means and can make long sections of the road hazardous. Curves and grades are critical points under icing conditions, and high-crowned roads can become difficult to travel at any point when iced over.

Use of Salts. At the beginning of a storm, apply sodium chloride or calcium chloride to wet snow and sleet to keep it in a slushy condition and prevent it from sticking to the surface. Limit the use of salts on concrete pavements to one or two applications per year or the pavement will pit and scale. Salts do not damage bituminous surfaces. To prevent blockage of the drains by freezing. place bags of salts at drain inlets or catch basins so they do not obstruct flow.

Use of Abrasives. Treat icy pavements with abrasives and salts to reduce slipping and skidding. Sand, both treated and untreated; cinders; and crushed rock or slag screenings are commonly used. Other materials include pea gravel, coal stock, and coke screenings. The choice of materials is based on the availability and the length of the haul. Sharp, angular material embeds itself readily, and dark-colored material absorbs the most heat from the sun. Untreated materials are fairly effective on compacted snow but are easily blown or thrown from the traveled way.

For the most effective use, mix calcium chloride with abrasive material. The calcium chloride causes the abrasive to embed in the ice and improves surface traction. Treat abrasives with 40 to 75 pounds of calcium chloride per cubic yard for stockpiling, and add another 25 to 50 pounds per cubic yard of calcium chloride when applying it to a road. Sodium chloride may be used in place of calcium chloride but is not recommended for temperatures below 10° F.

Store abrasive materials where they are quickly available when needed. Establish stockpiles for hand application at critical locations such as steep grades and curves. Make wider distribution with trucks by either hand or mechanical spreading. Heating an abrasive material before placing it on the road will allow it to melt into the ice and prevent it from being forced out by traffic.

Mechanical Removal of Ice. Graders can sometimes remove ice that is not tightly bonded to the road surface. Extremely icy conditions can be reduced by using scarifiers or rotary tillers equipped with special teeth. Exercise extreme care not to damage the road surface.

Correction of Spring Breakup Problems

In regions subject to frost and snow, spring is a critical time in the maintenance of

pavement and other traffic areas. Abnormal and repetitive traffic loads during the spring breakup period may cause subgrade pumping of concrete surfaces and breakthrough of bituminous surfaces. Melting ice and snow, spring rains, and frost leaving the ground all have a tendency to saturate permeable surfaces. Drainage obstructions may raise the water table and make subbases unstable.

Ditches. When the spring thaw begins, open ditches at critical points so that melted water will not flow onto the road. Outlets of cuts and road sections next to snowbanks require special attention. As the snow begins to melt, snowplows or grading equipment may be required to clear snow from the shoulders to avoid erosion. Handwork is usually required to clear the shoulders and open ditch outlets. Remove accumulations of ice in culverts and small drainage structures by hand or thaw them with truck-mounted steamers.

Frost Heaves. Frost heaves are indicated by the localized raising of road surfaces and pavements. Damage occurs as a result of the heaving of the subgrade soil due to the formation of ice lenses. This expanding subgrade causes an upheaval of the surface and subsequent reduction in overall strength. Frost heaves are most prevalent in silt and clay subgrades.

Frost Boils. Frost boils are indicated by the breaking up of a localized section of road surfaces and pavements when subjected to traffic. During thawing, the melted water produces a fluid subgrade condition with very limited or no supporting capacity. The traffic imposes a force on the pavement and thus to the excess water in the subgrade. This in turn exerts an equalizing pressure in all directions. This pressure is relieved through the point of least resistance (up through the pavement surface) and produces a small mound similar in appearance to an oversized boil.

Frost boils are often large and deep enough to make the road impassable until repaired. Repairs may be made by one or a combination of the following procedures:

- Bridge soft spots with timber, landing mats, sapling mats, corduroy, or other available material. Store materials in advance at or near load sections where frost boils may occur. Such repairs are temporary; therefore, remove the material when the road thaws and dries.

- Patch soft spots with crushed rock or gravel. Place large rocks in soft spots and cover them with smaller ones. It is better to remove soft, water-soaked material beforehand, although more time is required.

- For best results, provide adequate drainage along with the repair work to correct the cause of the problem. Remove soft material and dig an outlet ditch to one shoulder. A temporary bridge of planks or other material permits traffic to pass. The excavated soft spot and the ditch are backfilled with rock, gravel, or other suitable material. Drainage tile may be installed in the ditch before backfilling.

Preventive Maintenance

The best maintenance of any road is preventive maintenance. During the spring breakup, the best maintenance of a road subject to frost heaves and boils is to prohibit all traffic during the critical 2- or 3-day period. Methods to eliminate or minimize the damaging effects of frost action are discussed further in Chapter 12 of FM 5-430-00-2/AFPAM 32-8013, Vol 2.

FORDS AND BRIDGES

The approaches and bottoms of fords must be kept smooth and clear of large boulders and debris. Replace marking posts that have been knocked down or washed out. Refer to FM 5-446 for additional information.

Frequently inspect bridge abutments, trestles, piers, and trusses for damage and deterioration. Repair defects at the earliest opportunity. The maintenance crew normally obtains help to rebuild or repair the bridge.

AIRFIELD AND HELIPORT MAINTENANCE

Airfield and heliport maintenance is the responsibility of the primary user. For Air Force air bases, such maintenance is normally clone by an Air Force civil engineering squadron (CES) or similar unit. Army airfields and heliports arc normally maintained by Army engineer units. When the repair and rehabilitation requirements of Air Force bases exceed the immediate, emer gency-damagce recovery capability of the air base, Army engineer units will be assigned to perform the work.

AIR BASE DAMAGE REPAIR

The immediate, emergency-damage recovery of air bases generally is considered to be the minimum work required to permit aircraft to land and take off.

The Air Force is primarily responsible for the emergency repair of the air base. This includes the emergency repair of the air base paved surfaces, which is called rapid runway repair (RRR). This is accomplished through the employment of Air Force base civil engineering troop assets; prime base engineer emergency forces (Prime BEEF), and rapid engineering deployable heavy operational repair squadrons, engineering (RED HORSE) units. The Army is responsible for semipermanent construction, the byond-emergency repair of the air base and, upon request, emergency repairs which exceed the Air Force's capability. Joint service regulation AR 4 15-30/ AFR 93-10 specifics these repair responsibilities for each service.

Army Responsibilities for Air Base Damage Repair (ADR)

The Army provides engineer support to the Air Force overseas. It ensures that units are equipped, manned, and trained to support Air Force needs. This support includes—

- Assisting in emergency repair of war-damaged air bases where requiremen ts exceed the Air Force's organic repair capability.
- Repairing and restoring damaged air bases with beyond-emergency repairs.
- Developing engineer designs, plans, and materials to meet Air Force needs as agreed upon by the Air Force. Where practicable, designs will be based on the Army Facilities Component System (AFCS).
- Supplying construction materials and equipment, except for that provided by the Air Force.
- Upon request, assisting within their capabilities in the removal of UXO declared safe by EOD personnel and limited damage assessment operations.
- Managing and supervising the repair and restoration of war damage per - formed by Army personnel. The Air Force base comma nder sets the priorities for air base repair.

Air Force Responsibilities for ADR

The Air Force provides military troop engineering support from its resources. The Air Force ensures that units arc equipped, manned, and trained adequately to support its needs. This support includes—

- Emergency repair of war damage to air bases.
- Organizing host-nation support (overseas).
- Force beddown of units and weapon systems, excluding Army base development responsibilities.
- Operation and maintenance of facilities and installations.
- Crash recue and fire suppression.
- Managing force beddown and the emergency repair of war damage.
- Supplying material and equipment to perform its engineering mission.

- Providing logistical support to the Army for all classes of supply except II, V, VII, and IX.
- Conducting damage assessment and removal of UXO.
- Providing nuclear, biological, chemical (NBC) collective shelters and establishing and operating personnel and equipment decontamination sites for the air base and the Army. There are shortages of these assets on air bases, and support to army units may be limited.

Air base support agreements may be established in some theaters between the Air Force and the host nation where ADR support capability exists. These host-nation support agreements may include equipment, materials, and manpower assets.

For a detailed description of personnel, equipment, and material requirements and critical path schedules for repair of runways cratered by high-explosive bombs, refer to AFR 93-2. For a further, detailed discussion of general ADR, refer to TC 5-340.

TURF SURFACES

Plant grass to provide a turf surface on shoulders and all graded areas. Turf aids in camouflage, reduces dust, and minimizes erosion. Turf surfaces are limited to areas where the climate and soil are favorable. Table 8-1 gives the characteristics of many native grasses to aid in selecting proper grass seed or sod.

MUD CONTROL

Mud on the runway creates slippery surfaces that impede takeoff and increase the difficulties and dangers of landing. Muddy taxiway and runway surfaces decrease tire life and increase the wear and maintenance of brakes. Flying mud particles may damage propellers, rotors, and jet engines. Removing mud from wheels, struts, and fuselage is an additional maintenance burden.

Mud on airfield and heliport surfaces is either deposited by vehicular traffic from adjacent muddy areas or caused by subgrade failure because of excess moisture and the pumping of mud to the surface under traffic.

Enforce mud discipline by limiting access to taxiways only to required service vehicles. Also, remove mud from the wheels and undercarriages of vehicles before they enter the taxiway. The most satisfactory solution is to provide surfaced service roads to all hardstands.

Repairs

Localized soft or muddy spots in an otherwise satisfactory surface are repaired by replacing the unsatisfactory subgrade material with a more suitable one. If the muddy areas are widespread, it may be necessary to stop all traffic until the surface dries. In extreme conditions, resurfacing may be necessary.

Mud Removal

In some instances, surfaces may be kept in operational condition by removing the surface mud. Remove mud by hand shoveling, blading, or dragging. Light mud or slush is sometimes removed by hand or with rotary brooms.

When a grader is used on a landing-mat surface, take precautions to prevent the blade from tearing the surfacing. A satisfactory method is to bolt a 4- by 12-inch hardwood moldboard over the cutting edge and extending 2 inches below it. This provides a scraping edge with sufficient spring to remove the mud from irregularities in the landing mat, yet soft enough to protect the mat. A piece of 1/2-inch rubber belting (or the cap from a worn tire) bolted between the blade and the moldboard and extending an inch below the cutting edge makes an effective squeegee for removing light mud and slush. Grader operations for removing mud and slush from the runway are similar to those employed for snow removal. Start in the

Table 8-1. Characteristics of grasses

Name of grass grouped by region of suitability	Resistance to traffic wear and mowing	Preferred soil texture	Drought resistance	Acid tolerance	Rate of establishment	Method of establishment	Best season for work	Use in mixture with--
TURF GRASSES								
COOL, HUMID REGION								
1. Kentucky bluegrass (Poapratensis)	Good	Loam, clayey loam	Good	Fair	Slow	Seed, sod	Fall or spring	Number 2
2. Creeping red fescue and chewing fescue (Festuca rubra and festuca rubra fallax)	Traffic, good Mowing, fair	Sandy to gravelly loam	Good	Good	Fast	Seed	Early fall	White clover and number 1
3. Smooth brome (Bromus inermis)	Good	Various	Good	-------	Medium, fast	Seed	Spring	Mix with native grass
WARM, HUMID REGION								
4. Bermuda grass (Cynodon dactylon)	Excellent	Sandy to clayey loam	Excellent	-------	Fast	Sprigs, sod, or seed	Spring or summer	Seed alone or with carpet grasses
5. Common carpet grass (Axonopus affinis)	Good	Moist clays, clayey loam	Fair	-------	Medium, fast	Seed, sod	Spring or summer	Seed alone or with carpet grasses
6. St. Augustine grass (Stenotaphrum secundatum)	Fair	Moist, various	Fair	-------	Fast	Sprigs	Spring or summer	
DRY REGION								
7. Buffalo grass (Buchloe dactyloides)	Excellent	Clayey loam to loam	Excellent	-------	Medium, fast	Block, sod	Spring	Seed blue grama between buffalo-grass-sod blocks
ROUGH TURF AND BUNCH GRASSES								
COOL, HUMID REGION								
8. Common ryegrass (Lolium multiflorum and L. perenne)	Good	Various	Good	Good	Fast	Seed	Fall or spring	Number 9
9. Orchard grass (Dactylis glomerata)	Fair	Loam to clay	Good	Excellent	Fast	Seed	Fall or spring	Number 8
WARM, HUMID REGION								
10. Hairy crabgrass (Digitaria sanguinalis)	Excellent	Loam to clay	Excellent	-------	Fast	Hayseeding	Summer	
11. Bluestem (broomsedge) (Andropogan)	Fair	Loam to clay	Excellent	Excellent	Medium	Hayseeding	Fall	
12. Korean lespedeza (Lespedeza stipulacea)	Excellent	Loam to clay	Excellent	-------	Medium	Seed	Spring	
DRY REGION								
13. Little bluestem (Andropogon scoporius)	-------	Moist, sandy to loamy	-------	-------	-------	Seed, hayseeding	Spring	Other grasses suited to soil
14. Blue grama (Bouteloug gracilis)	-------	Loam to clay	-------	--------	-------	Seed, hayseeding	Spring	Seed between blocks of buffalo grass
15. Crested wheatgrass (Agropyron cristatum)	-------	Clayey loam to loam	-------	-------	Slow	Seed	Spring	Other native grasses

center of the runway and proceed progressively to the edge, overlapping several feel on each pass.

SNOW REMOVAL AND ICE CONTROL

Snow removal methods, the order of operations, and the assignment of equipment arc established in advance of the winter season. Factors to be considered in planning the snow-handling program are climatic condtions the average snowfall, the aircraft to be accommodated, the equipment available, and the camouflage requirements. Aircraft may be equipped with either wheels or landing skis. Ski-equipped aircraft operate successfully on packed snow. Aircraft with landing wheels cannot operate in more than 3 inches of loose snow. This limitation applies to fresh snow on a clear runway, fresh snow on previously packed snow, or melting snow previously packed on a runway. For camoflage it is undesirable to remove all snow from a runwav when the surrounding terrain is blanketed with snow.

Controlling with Equipment

Equipment useful for handling snow includes rubber-tired tractors, scoop loaders, graders rotary brooms, and band brooms. Supplementary equipment may include single-wing one-way, and reversible snow plows: V type plows; rotary plows; blowers; rollers; and other snow-removal equipment.

Packing

In regions of heavy snowfalls with prolonged cold weather relatively free from sudden thaws. snow may be handled by packing. The runway, shoulders, and as much adjacent area as practical arc packed. Rolling begins as soon as 3 inches of snow have fallen and continues during the snowfall. Snow is packed by rollers drawn behind a tractor with snow treads.

Smoothing is done with a drag equipped with metal cutting edges on the front and rear or with a grader. Usually one tractor is used to pull both the drag and the rollers, with the drag ahead of the rollers.

Rollers can be made to any desirable diameter and length with a shell of 10-gage corrugated steel. The shell is supported on an axle by two structural frames, or spiders, at the third points, and two steel-plated bulkheads at each end. One plate has a hole to permit filling the roller with sand to increase its weight.

Clearing and Removing

Snow clearing and removal are required where climatic conditions will not permit packing or where snowfalls arc in excess of that which can be packed on the runway. Remove light snowfalls with a grader or rotary broom. Very light snowfalls can be blown off the runway by the prop wash of Several aircraft lined up along one edge. Remove heavy snowfalls with truck-mounted plows, rotary snowplows, rubber-tired tractors, or scoop loaders. Drifts may be opened by a truck or tractor with a V-type blade or by a rotary snowplow.

Equip trucks with tire chains and carry ballast for traction while plowing. Keep all blades about 1/2 inch above the runway surface. especially if the surface is a landing mat. This clearance is accomplished by runners mounted at each end of the blade.

The assignment of plows varies with the condition at each air field and the type of equipment available. Arranging the plows into units simplifies coordination of snow removal with the control tower. Ordinarily, on c- way, truck -mounted snowplows operate in echelon to expedite snow removal. Remove snow near landing lights and other obstructions with a blower, if available, or by hand.

The rapid removal of snow requires a rotary blower, snow loader, or other special equipment. Trucks used for hauling snow arc equipped with nigh sideboards. Tractor-drawn sleighs built of lumber may be used as an expedient hauling device or to supplement snow-handling trucks.

Abating Ice Conditions

Sprinkle ice coatings on runways, taxiwavs, and hardstands with urea, coarse sand, or

cinders, spread by hand or by mechanical spreaders. If practical, heat abrasives before spreading. Remove accumulated abrasives in the spring by brooming, ice conditions on airfields used by jet aircraft arc a very serious problem because abrasives cannot be used. Do not use sodium chloride and calcium chloride for ice control without approval because these salts may promote corrosion of metal aircraft parts.

MAINTENANCE DURING FLYING OPERATIONS

Coordinate maintenance and repair work during flying operations, and plan the work for minimum interference with air and ground traffic. Much of the maintenance work may need to be done at night or during inclement weather in order not to interfere with flying operations.

Do not leave equipment hazardous to aircraft on the runway or other areas. Clearly mark construction or repair areas on the runway so that they are visible from the air. Mark repairs on taxiways so that they are visible to pilots while taxiing.

REHABILITATION OF CAPTURED AIRFIELDS

The decision to rehabilitate a captured enemy airfield and the decision as to the type and construction standard of the rehabilitated field are Air Force and Army responsibilities. The work is ordinarily accompi shed by a combat-heavy engineer battalion. The engineer mission is to convert the existing facilities, which arc usually damaged, to the standard decided upon by the Air Force and Army, with a minimum outlay of labor, equipment, and materials. Considerable discretion must be exercised in applying standard specifications to captured airfields. No large-scale relocation of facilities should be undertaken merely to conform to standard patterns, if the existing patterns will serve the same purpose in a satisfactory manner. Sensible, existing substitutions and deviations from specified arrangements must be recognized and accepted.

An appraisal of the damage done to a captured field precedes the decision to rehabilitate it. Occasionally, it is necessary to expend more effort to restore a badly damaged airfield than to construct a new one. The damage to the installation includes war damage by our forces in any battle for the airfield and the deliberate damage that the enemy did before yielding the field to our forces. Complete destruction of an airfield is a major undertaking; therefore, the enemy will likely resort to onc or more of the following less destructive measures:

- Placing delayed-action bombs, mines, and booby traps.
- Demolishing drainage systems and pavements.
- Placing obstacles and debris in the runway.
- Plowing turfed areas.
- Flooding surfaced areas.
- Blowing craters in runways, taxiways, and handstands.
- Demolishing buildings, utilities, and similar installations.

Assume these damages were inflicted when conducting such reconnaissance.

Use the criteria that follow to prioritize rehabilitation operations:

- When restoring a captured airfield, the first priority is to establish minimum facilities and utilities to include the establishment of a minimum operating strip for immediate operation of friendly aircraft. This also includes removing UXO, delayed-action bombs, mines, and booby traps from the traffic areas; clearing debris from those areas; and repairing craters on the runway and taxiway

surfaces. Promptly repair the drainage system. Concentrate runway work first on a minimum operating strip; second, on an access route; and finally, on other traffic areas. Give early attention to the provision of suitable sanitary and water facilities. Chapter 7 of TC 5-340 gives detailed information regarding these areas.

- The second priority is improvements to the minimum operational facilities. Restore remaining runways, taxiways, hardstands, parking aprons, access and service roads, and fuel and bomb storage areas before rehabilitating other, less vital facilities.

- The third priority is the repair of buildings such as the control tower, operational buildings, crew shelters, communication centers, and other maintenance facilities.

- The fourth priority is the camouflage of installations; the restoration of utilities (making use of any utility map and any available citizen labor familiar with the installation's utilities); and the repair or establishment of bathing, dining, and recreational facilities. A complete cleanup of the grounds, including the removal of debris and seeding and sodding, is the last phase of a rehabilitation project.