MISCELLANEOUS STRUCTURES AND APPURTENANCES

13.01 RETAINING WALLS

This manual is intended for internal guidance only and is not intended to create a legal or moral duty. Supervisors have discretion, based upon their expertise and the particular circumstances, to deviate from this manual and to conduct additional research or receive input from experts in other areas, as needed.

13.01.01 PURPOSES AND TYPES

A retaining wall is built to hold a mass of earth when there is insufficient horizontal distance to permit the soil to acquire lateral support by taking its natural slope.

Retaining walls have four principal and important uses in highway work:

1) **Reduction of the total width required for an excavation or an embankment where the depth of the cut or fill is great. Sometimes, the width of the right of way is insufficient to permit the development of the normal side slopes.**

2) **Reduction of earthwork quantities where the highway is built along the side of a hill with a steep slope.**

3) **Protection of an embankment close to a stream.**

4) **Protection of the roadway from slides or rock falls originating above or from slips in a fill below the roadway. Conventional walls built to control landslides most often require the moving mass of soil to be removed to below the failure plane and the footer placed on stable material. The excavation required often requires the roadway to be closed during construction. Drilled in place piling retaining walls eliminate the excavation associated with other wall methods and usually only one lane is closed during the drilling operation.**

This chapter discusses several types of retaining walls. The materials normally used for these walls are portland cement concrete, stone masonry, timber and concrete cribbing, masonry block, and steel and timber piling.

13.01.02 RETAINING WALL CONSTRUCTION

13.01.02.01 GENERAL

As you can realize by considering the purposes for which retaining walls are used, they are very important structures. When a new road is being planned and designed, the need for retaining walls is usually one of the principal features to be considered. If the conditions at a certain location indicate that a retaining wall will be needed, provision for the wall will be included in the construction contract for the new road, and the location and design of the wall will be shown on the contract plans. In some locations, the need for a retaining wall will not be evident until the road has been built and some unforeseen condition develops. It may then become necessary for a maintenance crew to construct the wall. For this reason, it is desirable that maintenance employees be familiar with certain features of the design and construction of the common types of retaining walls. Such familiarity will also help maintenance personnel to provide the continuing care necessary to keep retaining walls in an effective condition. When a Maintenance Supervisor is called upon to build a retaining wall, one of the first requirements is to request assistance from the Materials Control, Soil and Testing Division. Specialists in this Division are able to obtain subsurface information by core-drilling and to make recommendations in regard to the foundation and type of wall that will be best for the particular condition. If there is underground water which may cause trouble, those specialists can be of help in locating its source and suggesting measures for its control. Such matters are discussed in detail in Chapter 09.

13.01.02.02 TYPICAL DESIGN FOR CONCRETE AND STONE MASONRY WALLS

A concrete retaining wall may be built entirely of plain concrete or concrete reinforced with steel bars. In a wall of stone masonry, the stone blocks may be laid with or without cement mortar. Either type of concrete wall or stone masonry wall may be used satisfactorily for any of the purposes listed in Section 13.01.01, if a uniformly stable foundation is available and proper drainage facilities are provided. However, such a rigid wall will crack and fail as a result of uneven settlement unless it is supported on a firm, uniform foundation below the frost line. Also, proper drainage is essential to prevent water from seeping through cracks and joints and causing progressive disintegration and eventual failure of the wall.

Suitable dimensions of stone masonry walls for two conditions are shown in Figures 13-1 and 13-2. When the surface of the earth behind the wall is level, as in Figure 13-1, there is no surcharge. When the surface of the earth behind the wall slopes upward from the back of the wall, as shown in Figure 13-2, there is a surcharge. Dimensions of plain concrete walls for similar conditions are shown in Figure 13-3 and 13-4. For each of these four cases, a table is included stating the quantities of materials required for each foot of wall. The dimensions and placement of steel for a reinforced concrete retaining wall are shown in Figure 13-5, which shows a sketch of a typical section.

13.01.02.03 DRAINAGE OF FILL BEHIND CONCRETE OR STONE MASONRY WALLS

While a retaining wall of concrete or stone masonry is being constructed, provision must be made for the escape of water that will collect in the earth behind the wall. To permit water to pass through the wall, small drains called weep holes or weep drains are provided approximately 5 feet apart slightly above the footing, as shown in Figures 13-l, 13-2, 13-3 and 13-4. In each case, drains 4" in diameter are called for at intervals of 5' 0" center to center. The slope of a weep drain must be steep enough to carry the water away rapidly.

In order that the water in the backfill material behind the wall may flow to the weep drains readily, a layer of crushed stone, gravel, crushed slag or other clean coarse granular material is placed between the back of the wall and the earth backfill in the manner shown in Figures 13-1, 13-2, 13-3, 13-4 and 13-5. The layer of granular material is placed while the backfilling of earth is being done. It must be at least 18" thick and extend from the top of the footing to one foot below the surface ditch. It covers the entire back of the wall, so water will not collect in the backfill but will drain along the back of the wall and will escape through the weep drains. A cover of impervious material approximately 12" deep is to be placed over the layer of granular material one foot below the top of the wall and sloped to facilitate drainage of surface water. Consideration should be given to enclosing the granular material in filter fabric to prevent clogging of the drainage by soil particles.

Before the granular material for drainage and the earth backfill are placed behind a concrete wall, the back of the wall should be examined carefully for porous or "honeycomb" areas and poor construction joints. All cavities must be well filled with a mortar of cement and sand to prevent infiltration of water. Also, a coating of waterproof material should always be applied to the back of the wall to facilitate the shedding of water.

When a large quantity of water flows through the backfill behind a wall, or the wall is on a steep grade, a tendency exists for the water behind the wall to run along the back of the wall for its full length instead of finding its way to the weep drains. In such a case it is necessary to install, in addition to the weep drains, a perforated pipe which is placed at the level of the weep drains and extends for the full length of the wall. The location of a typical perforated drain pipe along the back of a wall is shown in Figure l3-6. This perforated drain must have sufficient fall to carry water to the point of disposal rapidly and the outlet must be protected by a small headwall of concrete or stone masonry.

13.01.02.04 PILING RETAINING WALL

A piling retaining wall is most often built to control landslides, but may be used to widen a road in a cut or fill. The piles are normally anchored into bedrock a minimum of ten feet. The factors to consider when selecting locations where piling will

be cost effective are: expertise of installation crew, physical nature of the site, roadway alignment, utilities, right of way, and cost. Figures 13-7 and 13-8 show typical details of proper installation of piling, lagging, and walers. Many of these factors can be evaluated in the office or during a site inspection. Several core borings may be required for a thorough evaluation of the installation.

Steel piling is the material of choice; however, timber piles can be used for correcting shallow failures or constructing low walls.

The steel piles are usually wide flange beam or H-pile sections. H-piles are sometimes stockpiled by the Division and are more commonly used. Timber piles are most often utility poles. A continuous waler is used to tie the piles together by attaching it to the outside flanges of steel piling or the outside face of timber piling. These walers are light steel sections of angle, channel, or T-section made by cutting the pile section along its web.

Lagging is used between the piles to prevent the backfill material from moving between the piles. The lagging extends at least two feet below the existing ground line. The lagging should be kept level and joints even to make the installation look good. Several types of lagging are available. Treated wood lagging (3" x 8" oak) is inexpensive, easy to install, and has a long life. Concrete and steel lagging are more expensive and more difficult to install. Salvaged guardrail can be used but it is difficult to keep aligned.

The equipment necessary to make a good piling installation is a foundation drill capable of drilling a hole in bedrock of sufficient size, and equipment to lift and set the piles. The diameter of the hole must be at least two inches greater than the diagonal of the pile. The remaining equipment such as a backhoe, trucks, cutting torches, welders, and saws are available as standard Division equipment.

Piling should be placed so as to restore the original roadway template or widen the shoulder if the right of way and utilities allow. The piles are generally placed on four foot or less centers because four feet is the longest span the soil will make without continuing to move between the piling.

A grout mix of 2000 PSI compressive strength is the ideal hole backfill material. The grout ensures a good connection between the pile and bedrock and maintains the rock integrity. Sand or fine gravel can be used as backfill but care must be taken to ensure the material reaches the bottom of the hole.

13.01.02.05 CRIB WALL ADVANTAGES

In a crib wall, structural members of concrete, timber, or metal are connected to form a series of cribs, which are filled with approved granular material. The stability of a crib wall does not depend entirely on the weight and strength of the

structural members. The weight of the granular material in the cribs also helps to hold the wall in place.

Walls of the crib type may be used for any of the purposes listed in Section 13.01.01. The following features make the use of a crib wall advantageous in certain situations:

l) It facilitates drainage of water which might collect behind a solid wall.

2) It can be built without forms, special equipment or skilled labor.

3) It may be loaded immediately after it has been built.

4) It can be built in short sections, so the amount of shoring and falsework needed to prevent a cave-in is reduced to a minimum.

5) Units of precast concrete, timber or metal may be stocked for use in an emergency.

6) If the wall is removed, the units may be salvaged and used repeatedly in other locations.

13.01.02.06 CRIBBING DETAILS

Typical designs of concrete cribbing together with tables for estimating quantities are shown in Figures 13-11 and 13-12. In the tabulation in Figure 13-11, "E" represents the end panel and "I" represents the intermediate panel. Designs for timber cribbing are shown in Figure 13-13, which consists of two parts. One part shows the layout of the elements and the other gives information about their sizes and the required number of pieces of each design. No designs for metal cribbing are included in this Manual because metal would not normally be used by maintenance personnel due primarily to unavailability. In the event it is necessary to construct a metal cribbing, the design and details will be provided by the District Office or the materials supplier.

13.01.02.07 CRIBBING REQUIREMENTS

Unless it is definitely known that a wall with timber cribbing will be only a temporary installation, the timber units must be properly treated with a preservative. Used railroad ties are good units for timber cribbing.

Acid has a deteriorating effect on metal that does not have a suitable protective coating. Where there is any evidence of the presence of mine water or water containing industrial waste, metal cribbing must be properly coated.

In general, concrete or metal cribbing that is manufactured commercially will be required to conform in all respects to the "Standard Specifications" or "Special Provisions" of the West Virginia Division of Highways. Metal cribbing must be sampled, tested and approved by the Materials Control, Soil and Testing Division in accordance with the prescribed procedures prior to acceptance. This same procedure must be followed in connection with the commercial manufacture of precast concrete cribbing.

13.01.02.08 FILLING CRIBS AND PLACING BACKFILL

Approved granular material will be used for filling the cribs, and the space in back of the cribbing will be filled with selected backfill material that is free of large rocks and large lumps or clods. The backfilling material and the granular material for filling the cribs will be placed while the cribbing is being erected. The surfaces inside and outside the cribs should be kept at the same level. All material will be placed in layers not more than 4 inches in depth and each layer will be thoroughly compacted by means of an approved mechanical tamper.

In most cases, it will be desirable to install a perforated drain pipe behind the wall near the bottom, as shown for a solid wall in Figure 13-6.

13.01.02.09 GABION WALL

It is sometimes advantageous to construct a retaining wall in the following manner: A suitable number of large rectangular baskets of convenient sizes are made of zinc-coated wire mesh and vertical diaphragms are inserted at intervals of about 3 feet. Individual baskets are set in position one at a time and each is filled with small rocks. When a basket is placed, it is wired to the adjacent baskets. The baskets are arranged in layers or courses to form a retaining wall of the desired height. Construction of this type can also be used to protect the bank of a stream.

The only equipment required to construct a gabion wall is a truck to deliver the gabions and stone, a backhoe to excavate the foundation and place the stone, wire cutters and pliers. Several baskets can be put together at one time and a complete row placed before backfilling.

The gabions can be constructed with a stepped front or a stepped back face. The bottom row of baskets is placed on two feet of stone to provide a solid, free draining foundation. The backfill can be compacted random fill. Figures 13-9 and 13-10 show a typical installation.

13.01.02.10 CONCRETE BLOCK RETAINING WALL

A concrete block retaining wall can be constructed in place of a standard low concrete retaining wall. The foundation for this wall is the same as a reinforced concrete wall. The wall stem consists of concrete blocks with reinforcing bars and

grout in the block cavity. This type of wall can be built in short sections with few tools required. Horizontal joint reinforcing is used in alternate rows to provide additional stiffness. This type of wall design is site specific as is the reinforced concrete wall.

13.01.03 INSPECTION AND MAINTENANCE OF WALLS

13.01.03.01 IMPORTANCE OF WALL MAINTENANCE

Many times maintenance personnel presume that a retaining wall, once it is built, is a permanent structure requiring little attention. As a result of such an attitude, many failures occur that could have been prevented by proper inspection and repair. One of the important duties of a maintenance supervisor is to make a periodic inspection of every retaining wall in the County or District regardless of its type or age.

13.01.03.02 SOLID WALL ALONG STREAM

The ends of a solid retaining wall beside a stream must be observed carefully, particularly after high water, to determine if the stream has started to cut around, behind, or underneath the wall. Such cutting sometimes occurs because the wall was not made long enough. In other cases, the wall was not built in the proper location. Many walls have been washed out because the ends were not properly tied into the natural ground or the embankment.

If a wall beside a stream has been damaged by stream action but the damage is not sufficient to have caused serious displacement or breakage, further damage often may be prevented by lengthening the wall at the damaged end. The following repairs may be necessary: If material has been undercut from beneath the wall, it must be replaced with concrete or rock ballast that is grouted with cement mortar. If fill material or natural ground has been washed from behind the wall, it must be replaced with good, select backfill material that is properly compacted. If the wall has been dislodged, little can be done except to remove and replace the wall.

13.01.03.03 OTHER SOLID WALL MAINTENANCE

A small retaining wall is sometimes built on a foundation of soil or shale in the cut portion on the side of a hill to maintain minimum shoulder width for a short distance. Such a wall gives good service as long as the foundation remains intact; however, the action of water on the soil or shale can reduce its supporting power and cause failure of the wall. If the wall is inspected often and necessary minor repairs are made before serious erosion has taken place, failure of a small wall can often be postponed or prevented.

Seepage of water through cracks or construction joints in a retaining wall is a danger signal. Such seepage shows that the drainage system is either inadequate or not functioning properly. Unless steps are taken promptly to determine the cause and make the necessary correction, disintegration of the wall will begin and continue

progressively. In some cases, correction may be effected by drilling one or more weep holes through the wall and tapping the source of the water. Weep holes must be inspected regularly to insure that they continue to function. Over a period of years, particularly in the case of a concrete wall, mineral salts tend to accumulate and fill the openings. Such clogging may require cleaning of drainage passages from time to time.

In the case of a wall built of stone masonry with mortar, the joints will have to be repointed at irregular intervals. Also, if a stone drops out or disintegrates because of frost action or other reason, it must be replaced carefully. A dry stone wall must be inspected at regular intervals, because this type requires more maintenance than a stone wall with mortar or a cement-concrete wall.

Maintenance of a timber retaining wall is confined almost entirely to replacement of the sheeting or lagging.

13.01.03.04 CRIB WALL MAINTENANCE

Ordinarily, a crib wall requires little maintenance. Unless there is a major disturbance of the units of cribbing in the wall, there is little danger that the wall will fail. If brush or a small tree grows through a crib wall, it must be removed. Tall weeds and grass near timber cribbing must be kept cleared because of the fire hazard.

13.01.03.05 PILING WALL MAINTENANCE

The piling wall requires some periodic maintenance such as painting the piling and lagging, or replacing deteriorated lagging.

13.01.03.06 FREQUENCY OF INSPECTION

All retaining walls and cribbing must be inspected yearly and the condition recorded. After the Maintenance Engineer has reviewed the reports, additional inspections of specific walls may be required. After a qualified person has made an investigation of each wall requiring attention, detailed instructions in regard to necessary repairs will be issued.

13.02 CURBS, GUTTERS AND SIDEWALKS

l3.02.01 USE

Curbs, gutters and sidewalks along highways are ordinarily found only in urban and suburban areas, and only under certain conditions. A curb or curb and gutter may be needed to facilitate surface drainage, and a sidewalk for the use of pedestrians. Curbs are also found around traffic islands where there are paved median strips or along paved areas for channelizing traffic.

13.02.02 TYPES

A curb is usually constructed of portland cement concrete. However, cut stone, bituminous concrete or some specialty material is sometimes used. Portland cement concrete is generally used for a gutter. They may be a plain curb, an integral curb, or a combination curb and gutter.

A plain curb consists of a vertical or upright section of concrete which is placed along the pavement. The curb may be of the barrier type or mountable type. A barrier curb is intended to prevent or discourage traffic from crossing. Although a mountable curb acts as a guide to the vehicle, it can be crossed or driven over without excessive driver discomfort or damage to the vehicle.

Another type of upright curb is used along a new pavement of portland cement concrete. Although such a curb is built separately, it is tied to the pavement with steel tie bars and a keyway.

When the pavement is of portland cement concrete, curbing is sometimes built as an integral part of the pavement. An integral curb may be of the barrier, semi-mountable, or mountable type.

In the case of a combination curb and gutter, as the name implies, the curb and the gutter are built as a unit. Such a unit can be used with any type of pavement construction. The curb portion of the combination may be of the barrier, semi-mountable, or mountable type.

Every new permanent sidewalk should be constructed of portland cement concrete. It may be placed either on an approved subgrade or on a granular "dry bed." Sidewalks are sometimes constructed of bituminous concrete, surface treatment, compacted gravel, or some specialty material.

As a general rule the Division of Highways does not have responsibility for the maintenance of curbs and sidewalks within an incorporated city or town. In other words, the Division generally maintains only the roadway from the face of one curb to the face of the other. The curbs and sidewalks are to be maintained by the municipality. Before a curb or sidewalk is repaired, the maintenance supervisor must ascertain the Division's responsibility for the work.

13.02.03 INSPECTION

13.02.03.01 FREQUENCY OF INSPECTION

It is the duty of maintenance personnel to have a continuing inspection program of all curbs, gutters and sidewalks which are under the jurisdiction of the Division of Highways. If maintenance is required at any location, a detailed investigation will be made by qualified personnel and the necessary repairs will be

scheduled. Early detection and repair of a weakened structure before serious damage has occurred can reduce the hazard and inconvenience to road users and lessen the cost to the Division.

13.02.03.02 TYPES OF FAILURE

Curbs, gutters and sidewalks will be examined periodically for settlement, cracks or breaks, disintegration, poor joints and the presence of dirt or grass.

Settlement or subsidence results from lack or loss of support from the underlying subgrade or natural ground. It is usually caused by erosion. In some cases the cause is lack of compaction of the subgrade.

Cracking or breaking can occur as the result of freezing-and-thawing action, a traffic accident, interference of tree roots, or settlement.

A possible cause of disintegration is poor construction materials, action of salts used for ice control, or overfinishing during construction.

Joints in curbs and gutters must be kept sealed to prevent leakage of water under the pavement. Asphaltic material forced from a joint must be removed, or the gutter will not function properly.

If dirt accumulates in a gutter or grass grows through the joints, the gutter cannot function properly. A curb or a sidewalk will sometimes deteriorate quicker if there is a heavy deposit of dirt (or even sod) on it than if it is kept clean. Grass growing through joints and cracks in a curb or sidewalk spoils its appearance and may also cause damage.

13.02.04 CONSTRUCTION

Ordinarily, when a long portion of curb, gutter or sidewalk is to be constructed, a contract is awarded for the work. On a new highway facility, the construction of curbs, gutters and sidewalks is usually included in the overall contract. In any event, responsibility for the design and construction of these appurtenances does not usually come within the jurisdiction of the Maintenance Division. Hence, a detailed discussion of methods of construction does not properly belong in this Manual. However, a maintenance crew is often called upon to repair or replace a portion of a curb, gutter or sidewalk. In such a case, reference will always be made to the provisions in the "Standard Specifications" pertaining to the items and the requirements of those Specifications will be followed.

13.02.05 MAJOR REPAIRS AND MAINTENANCE

13.02.05.01 SCHEDULING WORK

Before any work is done on a major project pertaining to the repair or maintenance of a curb, gutter, or sidewalk, site conditions must be examined very carefully. The adverse condition causing the need for the repair must be corrected or eliminated. Arrangements must be made to provide the required personnel, equipment, and materials.

13.02.05.02 PLAIN CURB SETTLEMENT

A portion of plain curb can be removed and replaced without disturbing the roadway pavement. If there is simple settlement or dislodgment of a portion of a plain curb, repairs can be made in the following way:

Step l: Backfill is removed from behind the curb for a suitable width and depth.

Step 2: The curb is raised by jacking, hoisting or other means, far enough to permit a sufficient quantity of select soil-aggregate mixture to be placed beneath the curb.

Step 3: The new soil-aggregate mixture is compacted and its surface is brought to proper elevation.

Step 4: The curb is adjusted so as to be in alignment at the correct grade and the backfill is replaced.

If dislodgement is caused by interference from tree roots, as many roots as necessary will be removed before the new select soil-aggregate mixture is placed under the raised curb. In the event that it would be impossible to raise the low portion of the curb without breaking it and without considerable difficulty, the only thing to do is to remove the portion of the curb that has settled and to replace it with new construction.

13.02.05.03 PLAIN CURB SHATTERING, SPALLING OR SURFACE DETERIORATION

When a plain curb is shattered or badly spalled, or the surface deteriorates, it is usually necessary to completely remove the damaged section(s) and construct new curbing to replace the removed portion. The new concrete must be cured properly to produce a good job.

Sometimes, permanent repairs can be made by patching the surface as that is more economical than removing a portion of a curb and replacing it. The proper procedures for patching are discussed in full in Chapter 8 of this Manual. However, minor depressions in the surface caused by spalling or deterioration of the concrete can seldom be repaired satisfactorily by patching, although good results may be

obtained by proper use of shotcrete or a suitable epoxy resin compound. Shotcrete is a mixture of cement, sand and water placed with the aid of compressed air. When epoxy resin material is used strict adherence to manufacturer specifications and instructions for placing must be followed. Shotcrete is to be used only in places where there is good sound concrete under the deteriorated or unsound areas.

No matter what material is used for patching, the most important phase of the work is the cleaning of the area before the patching material is placed. The proper methods for cleaning are discussed in detail in Chapter 8 of this Manual. Generally, however, sand-blasting and air-chipping equipment will be needed for this operation.

13.02.05.04 CURB TIED TO PAVEMENT

Settlement of a concrete curb that has been tied to the concrete pavement with tie-bars does not occur often. However, the top portion of such a curb is sometimes broken or otherwise damaged. To repair such damage, the concrete must be removed for the full width of the curb and for the depth to which the damage extends. It will not usually be necessary to disturb the steel tie-bars, and care must be employed not to break them loose from the concrete. New concrete is then placed to restore the curb to the proper section.

If the curb is damaged so badly that it must be replaced for its entire depth and the damaged portion includes an expansion joint, care must be employed to install a new joint in the correct location when the curb is rebuilt. In case a portion of a flexible pavement next to the concrete curb has been disturbed in the repair operation, the damaged portion of the pavement must be removed and replaced. New base and surface materials must be used for the reconstruction.

13.02.05.05 COMBINATION CURB AND GUTTER

The types of damage that can occur to a combination curb and gutter are the same as those described for plain curbing. Since a portion of a combination curb and gutter can be removed and replaced with little or no disturbance to the roadway pavement, the procedures to be followed in repairing any damage are, in general, much the same as for plain curbing.

13.02.05.06 INTEGRAL CURB

The operations involved in the repair of a concrete curb constructed integrally with the gutter and pavement are more complicated than the operations just described for plain curbing. Damage to the curb usually requires not only removal of the damaged portion of the curb but also removal of the portion of the pavement underlying the curbing. In other words, the concrete has to be removed to the elevation of the original subgrade. The edge surface of the concrete pavement that is exposed when the curbing is removed will be made as nearly vertical as possible. The recommended procedure is to make a vertical cut through the pavement by use of a

concrete saw of the type developed for cutting transverse joints in concrete pavements. The best location of this cut is along the theoretical junction of the pavement and the original curbing.

A curb of portland cement concrete must be built with the correct alignment and grade with the correct dimensions. For good results, the forms must be erected carefully and the concrete must be properly mixed and placed. The surface must be finished with great care to provide a good appearance. Concrete curb should only be constructed by a work crew that is skilled in this type work.

13.02.05.07 REPLACING CONCRETE SIDEWALK

If a sidewalk of portland cement concrete must be repaired, the damaged portion will be removed and new concrete must be used for replacement. If there has been settlement or extensive breakage, it will be necessary to examine the subgrade and to correct any defects. Therefore, if a dry bed is used, that bed must be removed as well as the concrete slab above. The subgrade must be made firm and uniform by rolling or hand tamping before new material is placed. Procedures for making repairs to the subgrade are described in detail in Chapter 8 of this Manual. When settlement or breakage occurs in a concrete sidewalk which has been placed on a dry bed, the granular material under the damaged concrete may be contaminated with soil. Usually it is not advisable to salvage material from the original dry bed.

Where breakage or tilting of a concrete sidewalk is caused by tree roots, the roots must be removed well below the surface of the subgrade. When new concrete is placed for a sidewalk, the expansion joints will be installed in the original construction locations.

In a locality where sidewalks are needed, there is usually a commercial plant producing ready-mixed concrete. When repairs to a sidewalk will involve a substantial quantity of fresh concrete, the use of ready-mixed concrete from this source is recommended. In a rural area or where only a small portion of sidewalk is damaged, it may be necessary to use a portable concrete mixer.

Major repairs or reconstruction of a concrete sidewalk on a bridge will not be undertaken without detailed plans from the District Bridge Engineer or the District Maintenance Engineer.

13.02.05.08 PATCHING CONCRETE SIDEWALK

As was pointed out in discussing repairs to curbs and gutters, shallow patching to repair surface disintegration in a concrete sidewalk is often unsatisfactory. A failure of this kind is progressive and it usually indicates some deep-seated weakness in the concrete which will not be corrected by surface patching.

When conditions indicate that a temporary patch is required in a sidewalk of portland cement concrete, it will be necessary to use an asphaltic concrete containing only fine aggregate (a sand-asphalt mix.) The exposed surface of the existing sidewalk will have to be cleaned and coated with tacking material before the asphaltic concrete is applied. The patch material must then be rolled with a hand roller or tamped with a hand or pneumatic tamper.

13.02.05.09 ASPHALTIC SIDEWALK REPAIR

A sidewalk of asphaltic concrete, being more flexible, is less subject to extensive damage by roots than a sidewalk of portland cement concrete would be. However, an asphaltic concrete sidewalk is subject to settlement if foundation conditions are bad, and has a tendency to crack if it is not used frequently. Repairs to an asphaltic concrete sidewalk that has failed will be made by removal of the failed areas, correction of subgrade problems, and replacement with suitable hot-mix material. An old asphaltic concrete sidewalk that has cracked may be given a seal-coal treatment with a sand cover, or a slurry, as described in Chapter 8 of this Manual. Preliminary leveling should be done where necessary.

13.02.05.10 CONCRETE REPAIR SPECIAL GUIDES

Special attention should be give to the following points in the repair of concrete curbs, gutters and sidewalks:

l) When concrete is mixed on the job or in the maintenance yard, only materials that have been previously approved by the Materials Laboratory will be used. When ready-mixed concrete is used, it will be obtained from an approved source.

2) Every effort must be made to match the color of a repaired portion of concrete with the adjacent undamaged section.

3) When new concrete is being prepared or placed in a repair operation, the requirements of the "Standard Specifications" governing the various details will be followed as closely as possible. Special attention will be given to the selection, proportioning, and mixing of the materials and to the placing, curing and finishing of the concrete. Re-tempering by adding water to concrete that has begun to set is to be avoided.

4) Broken pieces of concrete and other debris resulting from repair operations must be removed to a suitable disposal site. Larger fragments of concrete may be used for rip-rap in gullies, ravines, or around the ends of culvert pipe to help control erosion.

13.02.06 ROUTINE MAINTENANCE

13.02.06.01 JOINTS AND CRACKS IN CURBS AND GUTTERS

All joints and cracks in curbs and gutter will be inspected as a phase of routine maintenance. Every undesired opening will be sealed with material that has been approved for the type of construction. The methods and procedures to be used and followed are the same as those suitable for roadway pavement. They are described in detail in Chapter 8. The size of the job will dictate whether hand or mechanized equipment will be required. Asphaltic material extruded from a joint will be removed so the top of the joint will be flush with the adjacent concrete surface. This work will be done during hot weather when the greatest amount of material is forced from the joints. A long-handled scraper is a good tool for this job.

13.02.06.02 DIRT AND GRASS REMOVAL

Dirt will collect very rapidly in a gutter along a curb. If it is not removed, it interferes with the proper functioning of the gutter by holding back surface water. Also, when the water does run off, much of this dirt will be carried onto catch basins, which must be cleaned more often.

If dirt is allowed to collect on a paved surface, it may cause more rapid deterioration than under normal wear. After the winter season, the dirt contains some de-icing chemicals which were applied during the winter. These chemicals have a deteriorating effect on concrete.

All gutters will be swept in the spring and again in the fall before the start of winter rains and snows. If there is a deposit of dirt on a curb or a sidewalk in the spring, it will be removed to improve the appearance of the highway for the summer.

All grass growing through joints and cracks in curbs, gutters, and sidewalks must be removed. A program of yearly applications of soil sterilant should be instituted. This sterilant will normally be applied early in the spring (at the beginning of the growing season) and strictly in accordance with the manufacturer's directions. Such a program will not only result in a more pleasing appearance, but more importantly will kill vegetation whose roots will eventually damage the curb, gutter, or sidewalk by allowing water to penetrate.

FOOTNOTE

As more fully set forth in Section 01.01.01, nothing in this manual is intended to create a legal or moral duty and has been created for internal guidance only.